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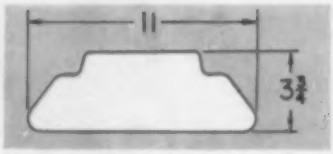

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ILLUMINATING ENGINEERING

THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY

October 1960

Vol. LV, No. 10

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Contents

517 Richard G. Slauer, IES President, 1960-1961

518 1952-1960, Five Footcandles to 185

519 Church Recreation Hall—William Tao

522 High Bay—High Levels

524 Move Up To Quality

525 Idea for Altering Apparent Dimensions

527 Lighting . . . Keyed to Today's Homes—Part I—Architectural Lighting

560 Significance of Numerical Results of Photometry—E. H. Salter

565 Lighting of Airport Service Areas—E. B. Karns

569 IES Lighting Data Sheet—Series XXV
Lighting a Hospital Laboratory (18-12)

9A Lighting News

23A IES National and Local Officers, 1960-1961

43A Residence Lighting Forum Officers, 1960-1961

47A Index to Advertisers

Sustaining Members—Refer to September 1960 Illuminating Engineering

STATEMENTS and opinions in articles and papers in ILLUMINATING ENGINEERING are the expressions of contributors and do not necessarily represent the policies or opinions of the Society. Official Society opinions are expressed only in official committee reports specifically approved by the Council of the Illuminating Engineering Society.

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More than 1800 fluorescent fixtures in Old American's new building help create this striking nighttime impression.

Architects: Voscamp and Slezak
Mechanical Engineers: Scott and Kinney

110 footcandles of glare-free illumination are maintained throughout, including this attractive lounge for employes.

How Old American Insurance Co. ended the great lighting search with Day-Brite

True to Missouri tradition, Old American Insurance Co. adopted a "Show Me" attitude when considering lighting for their new Kansas City headquarters.

Working closely with their architect and consulting engineer, they contacted their local power and light company engineers. Consulted the experts at General Electric's famed Nela Park. Even made their Addressograph Department a "lighting laboratory" and installed competitive fixtures side-by-side.

Result? For lighting effectiveness with high visual comfort, over-all economy with trouble-free maintenance, and pleasing appearance, Day-Brite lighting was the clear-cut choice.

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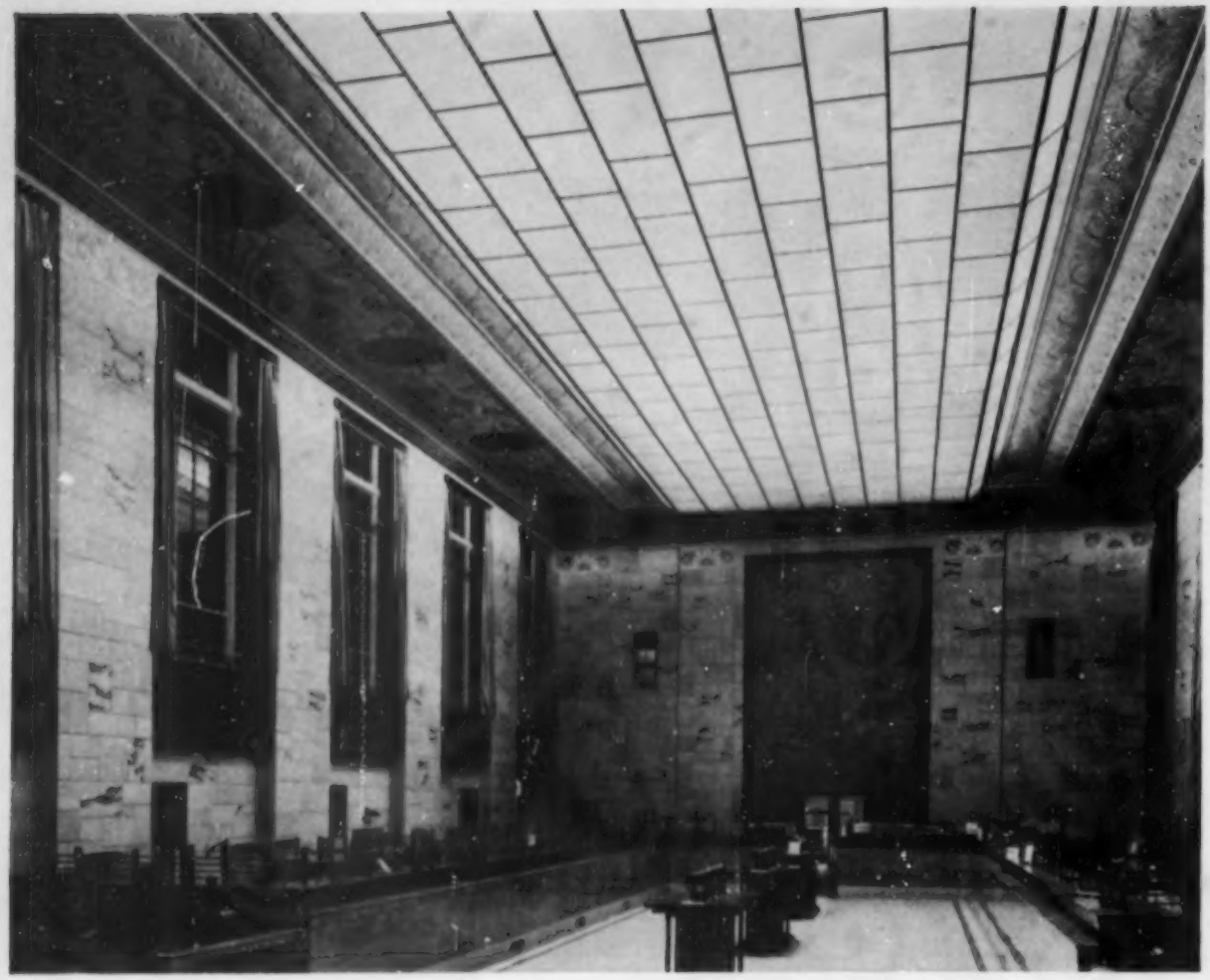

This Bank Gets a Public Relations Bonus For Its Lighting Equipment Money

When a bank's customers become vocal in their appreciation of the new lighting, that's good public relations. When the bank itself is pleased by both the lighting and customer response, that's good business!

This is a remodelling installation. Most impressive is the border of the luminous ceiling which has an upward slope of 30°, giving a picture frame or 3-dimensional effect* — a handsome choice for calling attention to the detail in the handsome frieze adjacent.

More practically, the intensity on the Tellers' Cage is now 100 foot-candles, average before was 5. If desired, intensity can be doubled by adding a row of lamps between existing rows. The equipment provides 45° shielding crosswise and lengthwise while diffusing the working plane with light. Light in weight, aluminum louvers save on installation expense and reduce the weight of the lighting system.

For *similar* results with standard, cost-saving equipment, specify Litecontrol.

** This modification of the Litecontrol standard ceiling is purely decorative.*

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Clark Lighting Services, Waterbury, Connecticut
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Eastern Electrical Construction Company, Bridgeport, Connecticut
DISTRICT SALES ENGINEER FOR LITECONTROL CORPORATION:
Harold R. Young, 6 Pratt Street, Rocky Hill, Connecticut
AREA: Banking Area and Public Area
CEILING HEIGHT: 24'-6"
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LUMINOUS CEILING:
2' x 4' white enamel finished aluminum louvers, 3/8" cube on aluminum inverted T-bars. 40 watt Rapid Start Lamps, 24" on centers, mounted on Kindorf channel.
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Richard G. Slauer

IES President, 1960-1961

AN ENGINEERING society's most appropriate leadership, it is usually agreed, is by an engineer. If this increases directly as the square of the engineering ability, the Society has assured itself of an active, successful year in its election of Richard G. Slauer as President. He is a most able engineer—a Fellow of IES, elected to this Grade in 1949, a member of AIEE and a registered Professional Engineer (Massachusetts). Further, he is an articulate, original thinker of proven executive ability.

In any introduction of Mr. Slauer, the word "dynamic" would be hard to avoid. His experience and energy have been applied for the Society and for the lighting industry in countless directions. Major progress in IES operations (publications, in particular) and numerous industry developments owe much to Mr. Slauer's initiative and conscientious work. To name a few:

The first *IES Lighting Handbook*, a monumental step for the Society, requiring experienced study and the working out of myriads of details. Without the work of Mr. Slauer and others of the Task Committee which planned the *Handbook*, this valuable project may never have been completed.

Equally complicated was the development of the new, expanded Society magazine, ILLUMINATING ENGINEERING. This too was a major project of vast change and improvement which owes much to Mr. Slauer's work on both the Task Committee which developed the idea and the Publications Committee which carried out the plans. These are, however, only two of some 25 IES committees on which Mr. Slauer has served, many of them as chairman.

Industry publications have also felt his influence. He was associated with the preparation and handling of one of the first mass correspondence courses on lighting (1930) with over 6000 correspondents and almost 2000 graduates. He also developed the detailed preparation of the *Handbook of Interior Wiring Design* which was the foundation of broad industry work on adequate wiring.

As further evidence of Mr. Slauer's dynamic contributions to lighting, one might cite his literally hundreds of lectures before IES and industry groups. One period of less than a year found him making over 500 field talks to acquaint the industry and public with the characteristics and expectations of the fluorescent lamp (1939).

Mr. Slauer's business career of over 34 years in lighting has been with three major lamp companies. Upon graduation from Stevens Institute of Technology (M.E., 1926, at the age of nineteen), he joined the General Electric Co. in Harrison, N. J., for four years. For some 14 years, he was with Westinghouse Electric Corp. in Bloomfield, N. J. Since 1944, Mr. Slauer has been associated with Sylvania Electric Products Inc., where he is now Manager of Engineering for the company's Fixture Division in Wheeling, W. Va.

In a year which promises further big advances —in research, service and membership growth—it is fitting and fortunate that IES be guided by a President such as Richard G. Slauer.

1952 - 1960

Five Footcandles to 185

From a random pattern of lighting fixtures yielding five footcandles of illumination, to a scientifically designed installation of 185 footcandles is the dramatic eight-year modernization of The Marquardt Corporation precision assembly machine shop in Van Nuys, Calif. In 1952, prior to the first modernization of the plant, the lighting system consisted of individually hung, two-lamp fluorescent units. Expansion of facilities in 1953 included the introduction of *planned* lighting. The two-lamp industrial fixture was still the basis of the lighting system, but a pattern of spacing and mounting height was established and, with an increase in the number of fixtures, 55 footcandles of illumination were made available.

The dramatic change, the first really adequate lighting in the plant, took place in 1960 following the installation of a new 4160-volt power distribution system with a master station and load center unit substations throughout. Unit substations provided utilization voltages of 480/277-volt 3ϕ four-wire wye. With adequate power available, an optimum lighting system was designed, using extra-high-output lamps in eight-foot fixtures. The 1960 installation decreased the number of fixtures needed, raised the mounting height and widened the fixture spacing (see table below). The wiring system, 480-volt 3ϕ Delta using three-pole circuit breakers eliminated the third and other odd harmonics that caused heavy neutral currents when fixtures were connected.

In addition to new lighting, the plant received a new coat of paint—ceiling and upper walls, egg shell white; lower walls, aqua green.

The Marquardt Corporation is engaged in the manufacture and precision assembly of Ram-Jet engines. Since the area is classified, no photograph of the work area can be shown.

Wiring and lighting systems were designed by the Marquardt Plant Engineering Facilities Design Section under the direction of Plant Engineer, W. M. Estelle. Electrical construction and installation by Marquardt personnel was supervised by Assistant Plant Engineer, F. E. Hamlin. Photo and data courtesy of Roy H. Kreyser, Department of Water and Power, Los Angeles, Calif.

Lighting Progress at The Marquardt Corporation Precision Assembly Machine Shop
Dimensions: 80 by 240 feet. Total Area: 19,200 square feet.

	1952	1953	1960
Type of Fixture	48-inch, 2-lamp industrial	48-inch, 2-lamp industrial	96-inch, 2-lamp industrial slotted reflectors
Number of Fixtures	96	336	192
Lamp Type	F40T12	F40T12	F96TD17/CW
Number of Lamps	192	642	384
Fixture Mounting Height	Approximately 16 feet	13 feet	21½ feet
Fixture Spacing	No definite pattern	5 feet	9 feet
Row Spacing	No definite pattern	10 feet	10 feet
Wiring System	120/240 — 10 — 3-wire	120/240 — 10 — 3-wire	480-volt 3ϕ Delta
Footcandles Maintained	Approximately 5	55	185

CHURCH RECREATION HALL

By WILLIAM TAO

Not all church lighting is in the nave. Tower Grove Baptist Church in St. Louis, Missouri, extends its spiritual ministrations in this well-lighted recreation building—for wholesome activity of its younger parishioners. Each of its major areas, illustrated on the following pages, is an example of the best in current practice for sports and recreational lighting. A unique feature of the gymnasium is its totally indirect illumination system, providing high levels with a low-brightness uniform background.

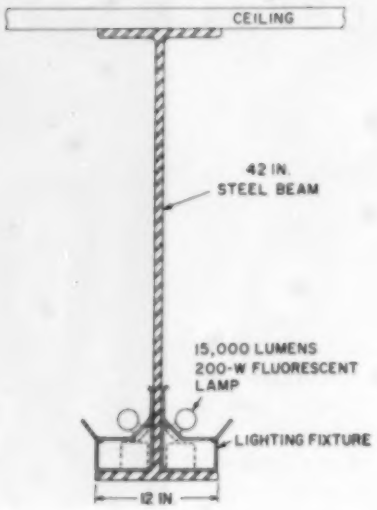
DESIGN FACTORS for all of the major areas in this church recreation hall—gymnasium, roller rink, table tennis room, and bowling alley—have been based on the visual requirements of the "task"—the specific sport involved. In most sports, either a ball, an athlete, or both, moves very rapidly. In order to meet the visual needs of this situation, illumination levels should be high, and background brightness as uniform as possible.

The ideal lighting system for a gymnasium would be high-level, indirect illumination, where high brightness concentration is minimized. In these circumstances, players and spectators alike can view the fast-moving ball (or person) against a uniform background. Economical factors have generally prohibited the installation of such a system in the past. Now, however, with current advancements in lighting application, and with the introduction of efficient high-output fluorescent lamps, this goal for ideal gymnasium illumination can be practically achieved.

According to the *IES Lighting Handbook*, the recommended illumination level in a gymnasium for college and tournament games is 50 footcandles. The illumination level at vertical planes is especially important, as the visual task is primarily viewed in this direction. An indirect lighting system inherently having cosine distribution char-

AUTHOR: William Tao, Consulting Engineers, St. Louis, Mo.

At left, angle view of the gymnasium showing lighting arrangement. Below, mounting details of fixtures.



GYMNASIUM

Amateur's snapshot at right was taken with the gymnasium lighting only; no flash bulbs were used. Note uniform brightness of background from indirect lighting system.

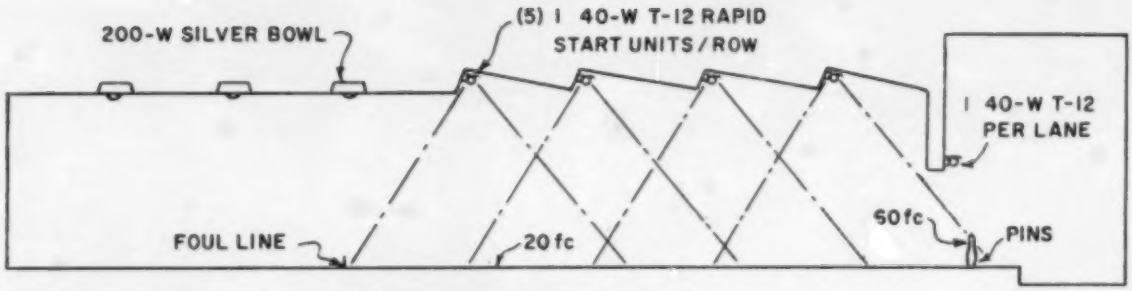
acteristics is particularly satisfactory for such an application.

After careful comparison betwen initial and operating costs, as well as between the quality of various systems, an indirect fluorescent system was selected for the illumination of the gymnasium in the recreational building of Tower Grove Baptist Church. Seventy 200-watt, 15,000-lumen lamps were used to provide an average of 50 footcandles on the horizontal plane and 35 footcandles on the vertical. In photo at top and especially in snapshot above, note uniform low brightness background.

Architects for this unusually effective recreation hall are Fitch and Nicholas, St. Louis; Electrical Contractor was Dorsch Electric Co. Credit for success of the project is due also to Mack R. Douglas, Pastor, Walter Matthews, Building Manager; Robert Raus, Recreation Director; and the members of the Building Committee, Tower Grove Baptist Church.

BOWLING ALLEY

Open cove lighting, which maintains 20 footcandles on the alley, and 60 footcandles on the pins, is shown in the picture at right and detailed in the cross section below.



RINK

Skating rink with minimum of 5 footcandles throughout and 15 footcandles on main runway.

TABLE TENNIS

Table tennis room has luminous ceilng providing uniform level of 60 footcandles over playing area.

High Bay—High Levels

Industrial areas, where benefits of adequate lighting are quickly measured in dollars and cents, have long been in the forefront of good lighting practice. Profits of relighting in the areas shown here further attest to the sense of the recommended levels.

Minnesota Mining & Manufacturing Company Warehouse

Demand for higher footcandle levels at the new Minnesota Mining & Manufacturing Co. warehouse in Philadelphia came from the plant engineer in charge of construction. More efficient working conditions, he realized, required an increase over the 10 footcandles of illumination in the old warehouse. The deciding factor in the increase of lighting level, however, was the IES recommended level, providing management with a justification for the increased capital expense.

The 49,000-square foot warehouse is lighted by two-lamp 48-inch 1500-ma rapid-start industrial units with 15 per cent upward component, 80 per cent downward component. Fixtures are installed on 12-foot centers at a 14-foot mounting height. After 200 hours of operation, measured illumination level in the warehouse was 48 footcandles with 60 footcandles on the loading dock.

To eliminate the need for operating numerous branch circuit breakers in the lighting panels for turning lights on and off, the design included contactors in each of the 42 circuit panelboards. The contactors are actuated by momentary contact pushbuttons at each door of the warehouse. In addition, "trail lighting" was provided to enable the night watchman to make his tour of the area without lighting up the entire warehouse.

The success of this lighting in increasing work rate and efficiency has convinced the company management of the validity of the IES recommendations. Plans now call for relighting an older warehouse to the same levels.

This installation which was designed by Harry B. Price, Consulting Engineer, Philadelphia, was entered in the Philadelphia Section's Applied Lighting Competition.

"White Room" at Hickok Instrument Co.

Scientifically-controlled environment with 300 footcandles of lighting has made startling improvements in production at the Hickok Instrument Co., Cleveland, Ohio. Quality levels have been raised 100 per cent, output increased 50 per cent and costs reduced by 20 per cent.

The "White Room," as the precision assembly area is called, is used for the manufacture of sensitive instruments with critical tolerances. Meters produced here, some of which contain over 200 small parts, are used in aircraft, missiles and space vehicles where minute accuracy is vital.

Since even a small piece of lint can cause an incorrect reading in the delicate instruments, the White Room has been "dust-proofed." Dust is removed from the room electronically; workers wear dust-free clothes which they brush with magnetic brooms and wipe their feet on two magnetic mats before entering the area. To prevent the entrance of dust through windows and doors, the room is pressurized at a constant level, 4 psi higher than surrounding areas. Temperature is held constant at 75 degrees, humidity at 45 per cent.

Lighting level of 300 footcandles from continuous rows of two-lamp eight-foot cool white high-output lamps diffused by a vinyl plastic ceiling permits the detection of minute flaws which were impossible to discover under the previous 100-footcandle illumination.

The room is 30 by 50 feet with a ten-foot ceiling. Reflectances are: walls, 70 per cent; bench tops, 20 per cent; floors, 10 per cent.

White Room production has so drastically reduced rejects of components and completed meters that Hickok is planning a similar 6000-square-foot facility for its Greenwood, Miss., plant.

Photo and data courtesy of General Electric Co., Nela Park, Cleveland, Ohio.

Beach Manufacturing Company

Simple but efficient lighting system, keyed to the structural pattern of the factory, designed to minimize reflected glare indigenous to the work task, is paying dividends at the Beach Manufacturing Co., Charlotte, Mich. in terms of greater production, improved morale, higher profits.

The reflected glare from the corrugated galvanized steel used in the manufacture of drainage culverts at the Beach factory dictated the choice of the linear fluorescent source and the grid pattern of lighting—surrounding the workers with light from all angles for a minimum of shadows and contrasts. Eight-foot, two-lamp industrial fixtures with 25 per cent upward component are mounted on 20-foot centers to fit the arrangement of support beams. Fixtures use 1.5-ampere extra-high-output lamps and are equipped with parabolic Alzak aluminum reflectors and parabolic louvers for maximum diffusion. Mounting height is 20 feet; spacing between rows, 12 feet. Illumination level after six months was measured at 50 footcandles, meeting the IES recommendation for rough assembly.

Lighting design by Dewayne R. Evans, Consumers Power Co., Lansing, Mich., was awarded second prize in the Western Michigan Section's Applied Lighting Competition.

◀ View of Zercher's Photo Shop showing general lighting from recessed troffers, valance lighting on greeting cards, recessed eyeball spots over showcase.

▼ Close-up of luminous wall background for camera and projector displays.

Move Up To QUALITY

DESPITE THE immediate impression that suburban shopping center stores are lighter, more spacious and more attractive than their downtown counterparts, the quality of construction in many of these stores has suffered from the maxim of "lowest possible cost" subscribed to by the promoters who build and rent them. Applied to lighting, "lowest possible cost" has meant more and more fluorescent strip for higher and higher footcandle levels and little attention to quality.

At the Gage Center, built in the summer of 1959 near Topeka, Kans., standard lighting pattern was 100 footcandles from bare fluorescent strip. One tenant of the Center, however, having experienced the benefits of a well-designed illumination system in a downtown branch, insisted on better lighting —despite the additional cost.

Zercher's Photo Shop occupied an area 20 feet wide and 40 feet long with a 10-foot ceiling. General lighting designed for the area is a system of 20 four-lamp two- by four-foot recessed troffers with polarizing glass fibre diffusers for a controlled illumination level of 120 footcandles. Valance lighting from 40-watt rapid-start lamps directs an additional 40 to 80 footcandles on a greeting card display. Cameras in floor showcases were highlighted by 150-watt PAR spots in recessed eyeball units, installed on four-foot centers, over the customer side of the display counters.

The real bonus of Zercher's custom-designed lighting, however, is the luminous wall background which transformed a bulky mass of cameras and projectors into an eye-catching display. Camera display cases were rebuilt to accommodate the lighting—plywood backs replaced by glass fibre panels, case depth increased by nine inches to house 72-inch T8 200-ma slimline fluorescent lamps on 12-inch centers, the cavity painted white for high reflectance. Projectors are displayed in 18-inch square angle iron cubicles with plate glass shelves against a lighted wall. The immediate effect of this lighting in turning an unattractive display into a sales asset prompted the owners to rebuild the display cases in their downtown store to incorporate the feature lighting.

Neil J. Thompson, The Kansas Power and Light Co., Topeka, designer of this installation, won second prize in the Heart of America Section's ALC.

IDEA FOR

Altering Apparent Dimensions

Broad bands of luminous ceiling and variations in ceiling height form a simple but exceedingly effective design for minimizing the "tunnel" effect of a long, narrow store.

Use of a strong horizontal accent to counteract an overwhelming vertical dimension is a proven technique for altering apparent proportions. This principle, applied to the Sandpiper Book Shop in Wilton, Conn., became a horizontal lighting design which solved the architectural problem of a very long, narrow store.

Basically, the solution to the dimensional anathema was the division of the 23- by 62-foot store into five approximately square areas. In terms of the lighting design, this was a pattern of alternating high- and low-ceilinged areas, with luminous sections in the low-ceilinged zones.

Emphasis is placed on the horizontal dimension of the bookstore by three luminous ceiling sections (at the center and the two ends of the store), each 10 by 13 feet with a four-foot plenum. These sections, which are enclosed by the side walls and by

three-foot-high bright yellow homastote baffles, house continuous rows of 40-watt rapid-start cool white fluorescent lamps mounted on less than two-foot centers. One-quarter-inch hexagonal cell aluminum louver material, painted white, supplies 45-degree cut-off for the downlight. Baffles stopped one foot short of the actual ceiling line add an upward component of light and with the lamp spacing ratio of .9 to 1 there is an ostensibly shadowless environment for the book display.

Bookshelf arrangement, suggested by the ceiling pattern, supplements the illusion of the geometric division of the store and provides a means for lighting the high-ceilinged areas. In the luminous ceiling areas, bookshelves are arranged along the walls; in the intervening high-ceilinged sections, they are placed back-to-back in the center of the store and parallel to the side walls.

Lighting for the high-ceilinged areas is from four asymmetric hour glass fixtures mounted on 16-inch crossarms at 90-degree angles and supported by a stem rising from the floor between the bookracks. Fixtures extending over the book displays are oriented so that the larger louvered ends which house 75-watt R30 floods are pointed at the books; the smaller ends, with 75-watt A lamps, aimed at the painted ceiling. Along the axis of the shelves, the hour glass fixtures are arranged with 150-watt R40 floods in the wider ends directed on the ceiling and 75-watt A lamps in the narrower ends pointed toward the floor. This arrangement provides 30 footcandles in the vertical plane of the books and sufficient light on the high ceilings to minimize the contrast between the luminous and painted ceiling sections. In addition, the satin aluminum hour glass units add decorative interest to the interior by providing the only interruption in the otherwise straight-lined design.

Bookshelves along the rear wall of the store, on either side of a door leading to the office, are washed diagonally by two 150-watt PAR38 spots mounted on the ceiling. A third spot in this ceiling cluster is directed at one of the yellow baffles with the reflected light, playing against the rear wall of the store, adding a warm hue to the lighting environment.

Over the check-out counter at the front of the store, lighting is by a surface-mounted stovepipe louvered fixture with 150-watt R40 spot. An office area (not visible) is lighted to 100 footcandles.

Color design, planned to improve the efficiency of the lighting system and to provide a stark background for the display of the vari-colored book covers includes: ceiling and walls, white, 82 per cent RF; desks and table tops, off-white, 80 per cent RF; bookracks, light grey with black trim, 52 per cent RF; two-toned asphalt tile floor, 50 per cent RF; baffles, bright yellow, 55 per cent RF.

The illumination level in the general sales area (70 footcandles in the horizontal plane, 30 footcandles in the vertical plane of the books) is slightly less than the IES recommendation for the area, but the quality and esthetic effect of the total design are notable. The designers have created a virtually glare-free environment with high visual comfort and crisp, stimulating surroundings for the prospective customer.

Sandpiper Book Shop lighting was designed by Douglas A. Worth, A. L. Harris and Associates, Wilton, Conn., with Zane Yost of Victor Christ-Janer, Architects, New Canaan, Conn. The installation was awarded first prize in the Connecticut Section's Applied Lighting Competition.

January 31—Deadline for 1961 Conference Paper Outlines

The IES Papers Committee has set January 31, 1961, as the deadline for submittal of outlines for proposed papers for the 1961 IES National Technical Conference in St. Louis. Outlines should be sent to:

Benjamin S. Benson, Jr.
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Lighting . . . Keyed to Today's Homes Part I

Prepared by the Subcommittee on Lighting . . . Keyed to Today's Homes of the Residence Lighting Committee of the Illuminating Engineering Society

Preface

The Residence Lighting Committee of the Illuminating Engineering Society has over a period of 30 years studied and reported on various applications of residential lighting. It has produced a number of technical publications based on detailed studies of lighting and seeing conditions for various seeing tasks in the home.

"Lighting . . . Keyed to Today's Homes" is a semi-technical publication intended for interior designers, architects and educators as well as home lighting specialists. This material has been prepared to replace the 1950 non-technical report entitled "Contemporary Lighting in Modern and Traditional Interiors." "Lighting . . . Keyed to Today's Homes" was approved by the Council of the Illuminating Engineering Society in February 1960. A Transaction of the IES.

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Acknowledgments

The Committee wishes to express to members of the American Institute of Architects, American Institute of Decorators, National Society of Interior Designers, and to Professional Lighting Designers sincere appreciation for their cooperation.

LIGHTING KEYED TO TODAY'S LIVING

This is the first installment of a report to be published in three parts, in the October, November and December 1960 issues of ILLUMINATING ENGINEERING. Following its publication in IE, the material will be available in booklet form, with special cover.

Lighting is one of the important aspects of any space. Through a change in light direction, quantity, or color quality, the mood or spirit of an interior or of its occupants can be varied because of the ways in which lighting affects one's perception of an environment.

Today's lighting developments, in both sources and methods, give architects and interior designers a greater opportunity than ever before to use their creative abilities to integrate modern lighting techniques with all current styles of interiors. Carefully considered lighting becomes a major element in a good design plan. To be harmonious with the character of the interior, it must be keyed in design and mechanics to the architectural and decorative pattern. To ensure satisfactory final results, there must first be a clear understanding between the client and the designer as to objectives—how the space is to be used and the needs of the occupants. Competent lighting knowledge is then needed to correlate these objectives with both the lighting requirements and the appearance factors.

Varied activity interests within multi-purpose areas require a flexible lighting system to meet individual and diversified seeing needs. Carefully planned lighting installations that provide for both functional and decorative requirements through the use of combinations of lighting methods and variations in light levels will increase the living potential of any home.

The purpose of this report is to acquaint designers with a variety of residential lighting techniques employed today. A review of the Table of Contents* indicates discussions of architectural lighting applications, fixtures, lamps, light sources, dimming equipment, and methods for lighting art objects, outdoor living areas and gardens. For the nonprofessional there is a guide to "Period Design Motifs" and a "Glossary" of lighting terms. Every attempt has been made in this report to present by the use of photographic illustrations, scaled dimensional drawings, and text, information of a practical nature for achieving lighting results that will be technically satisfactory and esthetically pleasing. The presentation of any one lighting solution, however, is not meant to imply that it is the only possible technique for solving the problem.

*Not published here. To appear in reprint version.

CHAPTER 1

Architectural Lighting

Architectural lighting may be defined as lighting techniques which are planned as an integral part of the structural design and decoration of an interior. Usually custom-designed and built to fit a particular situation, architectural lighting elements may assume various shapes, forms and finishes. Architectural lighting may be purely decorative or designed to provide functional lighting in a decorative manner. It may be applied to any type of architecture and to almost any room in the home.

The location, treatment, and installation of architectural lighting techniques are governed both by the design and decoration of a room, and also by the activities to be performed within the space. Whenever possible, custom-designed lighting should be planned when the house or interior is in the blueprint stage. However, it is not impossible to adapt some forms of architectural lighting as features in existing homes. Not all forms of this type of lighting require that the ceiling or walls be cut into in order to obtain unusual lighting effects; illustrations that bear out this statement are shown throughout this report.

The following discussion of architectural lighting in the home is divided into four classifications: Window and Wall Lighting, Cove Lighting, Recessed Lighting, and Luminous Ceilings and Walls. Other forms of lighting designed especially for decorative accent are discussed in a later chapter.

Window and Wall Lighting

Window areas, the daytime source of light, may also be utilized to provide functional and decorative illumination after the sun sets. Light installed at windows adds immeasurably to the enjoyment of the beauty of colors and textures in curtains and draperies. Such lighting sometimes results in a room that is more interesting and attractive by night than by day. In contemporary architecture the use of large areas of glass, usually covered by fabric after dark, almost demands some form of window drapery illumination to retain the concept of light emanating from these areas. When draperies are not drawn, lighting in the garden or on an adjacent patio is essential to maintain the daytime indoor-outdoor relationship. Otherwise, the glass becomes a dark mirror reflecting images of the interior. See section, "Light for Outdoor Living and for Gardens."*

In general, the objective in lighting window draperies is to produce illumination down over the extent of the fabric surface. The window and the drapery may extend from wall-to-wall and from floor-to-ceiling so one entire side of a room may be illuminated—or two or more sides to give a balanced lighting effect and create the illusion of greater space.

The same lighting techniques are used to light non-window walls. Wall lighting will emphasize a mural or scenic wallpaper, give a feeling of openness to a confined area, increase the visibility and enjoyment of a collection of paintings or other art displayed on a wall, provide illumination at wall-placed furniture, or contribute general background lighting.

The simplest form of window or wall lighting is to conceal tubular light sources behind a valance or cornice board. In modern lighting parlance, a *valance* is a horizontal strip mounted on the wall across the top of the drapery treatment. See Fig. 1. A valance usually directs light up to the ceiling as well as down over the drapery. A *cornice* is a horizontal member similar to a valance but attached to the ceiling; thus all of the light is directed downward. See Fig. 2.

There should always be lighting from other elements—fixtures, portable lamps, etc. so that opaque

*To be published in a later installment.

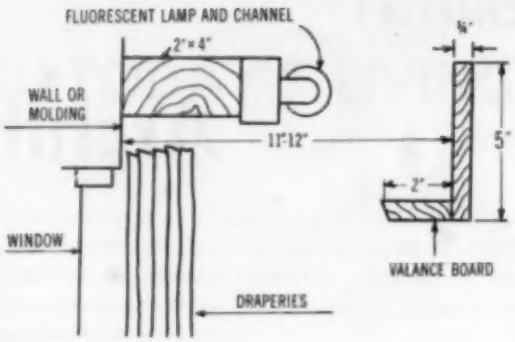


Figure 1. A lighted *valance* is a horizontal strip mounted on the wall across the top of the drapery, to conceal a continuous line of light which illuminates the draperies, upper walls and ceiling. Since the faceboard in this installation is located exceptionally far from the wall, a two-inch "return" at the bottom of the faceboard shields the light sources from view. Lighting Designer, Sylvan R. Shemitz.

valance, cornice and fluorescent wall bracket faceboards do not appear as silhouetted forms.

DESIGN OF FACEBOARD

The outside face of a wood valance or cornice board may be left in a natural finish, painted or covered with wallpaper or fabric; sometmes plastic or perforated metal is used to give a luminous or sparkling effect. The *inside* of the faceboard should be painted a flat white to diffuse and reflect the light. A faceboard designed to harmonize with the architectural and decorative elements in the room is most appropriate. It may be straight across or cut in scallops, swags or other shapes. The indentation of a scallop or swag should not be as deep in a lighted valance as it would be in an unlighted fabric valance. A minimum of 5½ inches should be allowed from the indentation to the top of the faceboard to prevent viewing the light source at the indentation point (the top of the channel being even with the top of the faceboard).

The faceboard of a valance may be tilted outward at the top to send more light across the ceiling, or it may be double tilted for added interest. In either case, the degree of tilt from vertical may be 15 to 20 degrees. If the board is tilted outward at the bottom some form of shielding (diffusing glass, plastic or louvers) may be necessary to prevent a direct view of the light sources. See Fig. 3.

Figure 2. A lighted *cornice* is a horizontal member similar to a valance but attached to the ceiling; all of the light is directed downward.

CURTAINS, DRAPERIES AND WALL SURFACES

Color and Reflectance

For effective window or wall lighting the fabric or wall surface should be light in color. Dark, somber colors absorb most of the light which falls on them and therefore are not very effective when lighted. Light, gay colors reflect light into the room and add to the pleasantness of the interior. Nonglossy wall finishes of medium reflectance, generally between 35 and 55 per cent, are desirable. Too high

Figure 3. The faceboard of a valance may be tilted outward at the top in order to send more light across the ceiling, tilted outward at the bottom (which may require some form of translucent or louvered bottom to prevent a direct view of the light sources), or double tilted for added interest.

reflectance may create excessive wall brightness, especially when large areas are involved. Low reflectance defeats the stated purposes of wall lighting, although the addition of light even to dark-colored walls will enliven them.

Location

In all cases glass curtains and draperies should be hung as close as possible to the wall or window frame so that the light from the tubes is distributed down the fabric and not intercepted by deep pleats in the drapery heading. Hooks should be close to the top of the draperies, or the heading will bend forward, interfering with the distribution of light. Box or cartridge pleats are preferred.

Length of Valance or Cornice

A small window can be given the illusion of greater width by extending the valance or cornice beyond each side of the window and mounting the draperies partially on the wall or from wall to wall. As a general rule, if the faceboard extends to within 12 inches of an adjacent wall, a more pleasing effect will result from extending the lighting treatment and draperies to the corner.

VALANCE LIGHTING

There are several factors that should be considered in the early stages of planning the use of lighted valances. One influencing dimension is the distance available above the valance. The top of

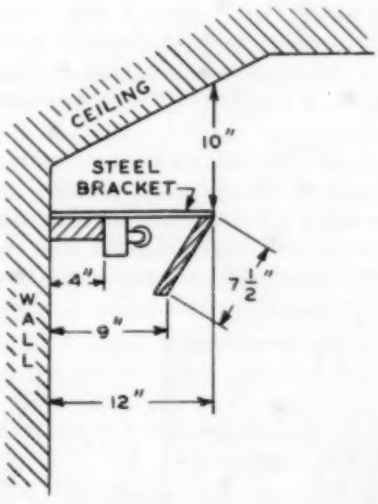


Figure 4. Tilted valance illuminating walls, draperies and sloped ceiling gives excellent general illumination in this contemporary room.

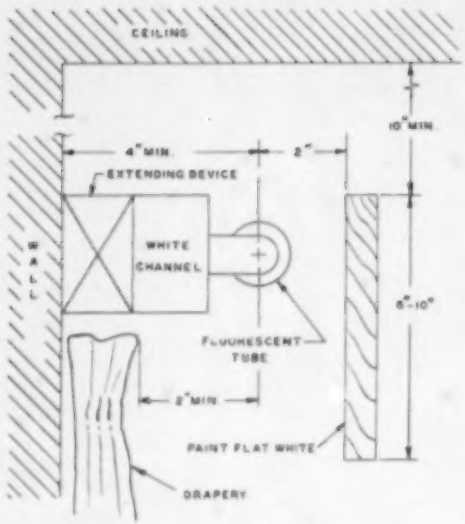


Figure 5. Minimum dimensions for achieving a valance installation with adequate shielding of tube and light distribution down the draperies, without an overly-bright streak on ceiling. Ten-inch minimum between valance top and ceiling is acceptable only if upper walls and ceiling have a reflectance between 65 and 85 per cent.

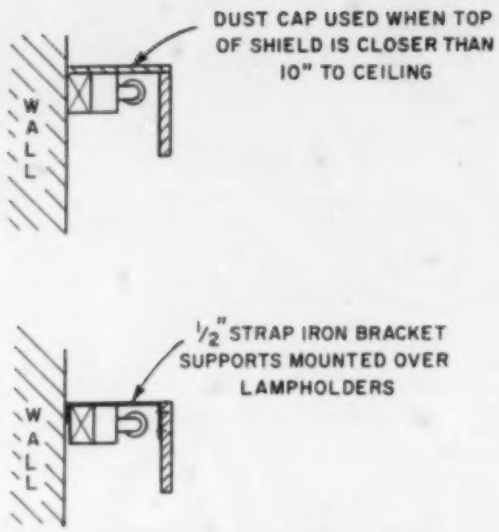
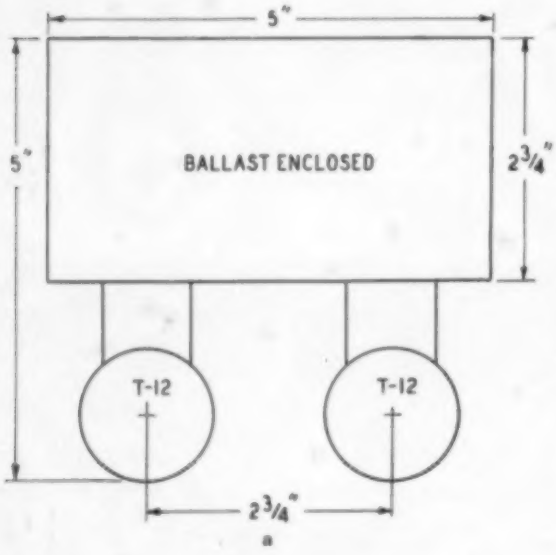

DUST CAP USED WHEN TOP OF SHIELD IS CLOSER THAN 10" TO CEILING
WALL
1/2" STRAP IRON BRACKET SUPPORTS MOUNTED OVER LAMPHOLDERS
WALL

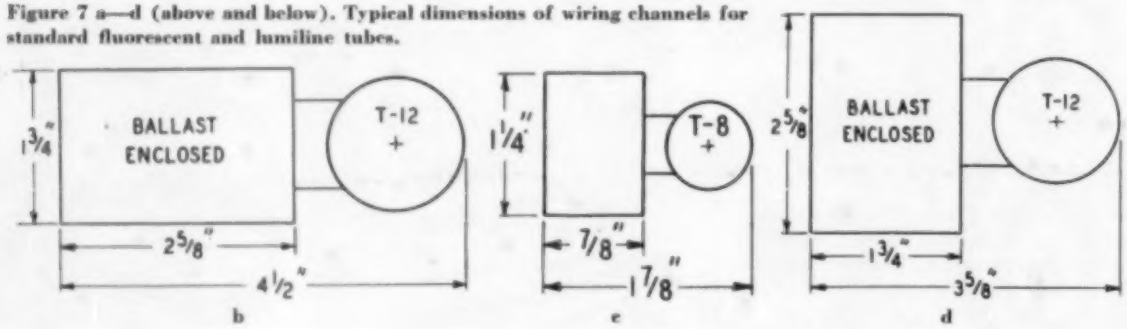
Figure 6. In instances where less than 10 inches is available between the top of the valance and the ceiling, the valance should have a top cover, painted white inside, to direct all light downward. When valance length requires metal supports, locate these supports over lamp holders (sockets).



the valance board should be about 12 inches down from the ceiling. A 12-inch or greater spacing permits a more extended spread of light across the ceiling which avoids a narrow and excessively bright streak directly above the valance. If the ceiling and the upper walls are very light in color (between 65 and 85 per cent reflectance), the valance top may be as close as 10 inches to the ceiling. See Fig. 5. Where less than 10 inches is available the valance should have a top cover (dust cap) painted white inside to direct all light downward, or a ceiling-attached lighted cornice should be installed if suitable to the interior design. See Fig. 6.

Before designing and installing valance lighting it is essential to know whether single lightweight draperies, or a combination of glass curtains and over-draperies, or heavily lined and bulky ones are to be used. These factors influence the positioning

Figure 7 a—d (above and below). Typical dimensions of wiring channels for standard fluorescent and lumiline tubes.



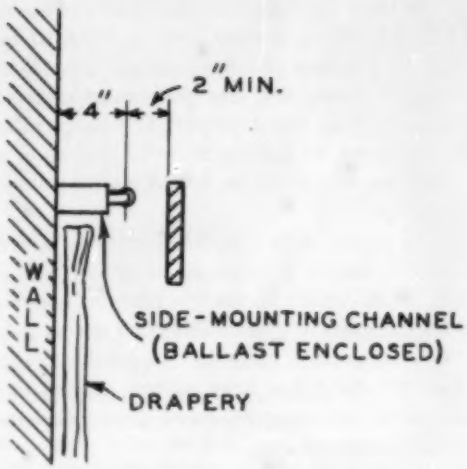


Figure 8. Channel which has the light tube mounted on the narrow side (side-mounting) can be fastened to the wall with little or no extending device.

of the light tube and the location of the faceboard. In every case, the center of the light tube should be *at least two inches in front of the drapery heading.* Careful adherence to this dimension and to the instructions which are detailed below will produce satisfactory lighting results over the length of the drapery.

Light Source Location Behind Valance

(1) Locate the light tube with its center at a *minimum* distance of four inches out from the wall when glass curtains or unlined draperies are used. This distance will have to be increased to five or six inches to position the tube center two inches ahead of double draperies or heavily lined ones. Physical size of channels varies (see Fig. 7); it is necessary to locate the channel out from the wall to meet the above requirements by mounting the channel on an extender acceptable to local code (wood blocks, metal supports, etc.). The extending device must be securely attached to the wall. The top of the channel should be installed so that it is in line with the top edge of the faceboard.

(2) Channel which has the light tube mounted on the narrow side (side-mounting) can be fastened to the wall with little or no extending device to attain the minimum four-inch dimension. See Fig. 8.

(3) The distance between the center of the light tube and the inside of the faceboard should be about two inches to facilitate replacement of the tube.

(4) When ballasts are not enclosed in the wiring channel but installed elsewhere, a smaller channel of lighter weight can be used. This smaller channel should be mounted on the inside face of the valance near the top. The small channel which is used for incandescent lumiline bulbs can be similarly mounted. See Fig. 9.

Faceboard Depth and Location

(1) The valance faceboard depth (from top to bottom) should be a *minimum* of six inches for lengths not more than eight feet. As valance length and/or ceiling height increase, the depth can be increased to eight to ten inches. A rule of thumb for the relation between valance depth and distance from floor to top of valance is that valance depth in inches can be about the same as distance in feet from floor to top of valance.

(2) The inside of the faceboard should be at least six inches out from the wall. When draperies are bulky or heavily lined or where a combination of glass curtains and overdraperies are used, the distance from the inside of the faceboard to the wall should be increased to seven or eight inches.

CORNICE LIGHTING

Light Source Location Behind Cornice

(1) Mount the wiring channel on the ceiling so that the center of the light tube is at a *minimum* of four inches from the wall for wall lighting, and a minimum of five inches from the wall if draperies are used. Keep the tube and channel close to the inside face of the cornice board. However, allow two inches from the center of the light tube to the

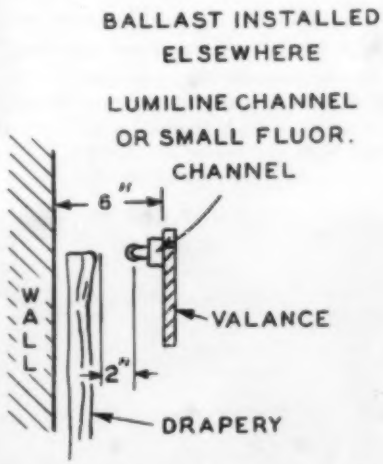


Figure 9. When ballasts for fluorescent tubes are not enclosed in the wiring channel, but installed elsewhere, a small light-weight channel, mounted on the inside face of the valance near the top, can be used. Small channel for incandescent lumiline bulbs can be similarly mounted.

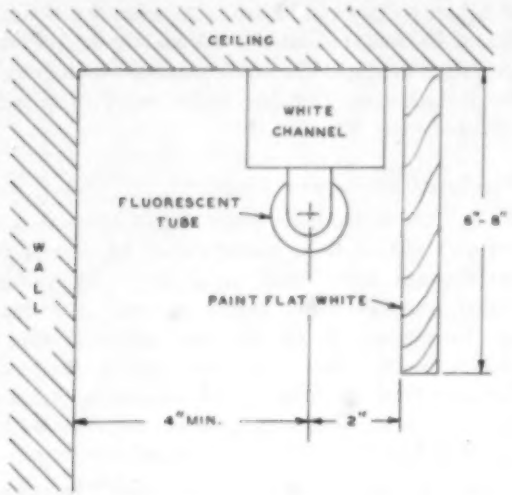


Figure 10. A cornice board installed as shown here will shield light sources at normal viewing angles and produce a pleasing wash of light down wall or fabric.

inside of the faceboard to facilitate tube replacement. See Fig. 10.

(2) Increasing the distance between the center of the light source and the wall or drapery will produce more uniform lighting on the wall or drapery surface.

Cornice Depth and Location

(1) When one row of small wiring channel is used (lumiline incandescent or fluorescent tubes with ballasts installed elsewhere) the depth of the faceboard may be a *minimum* of six inches. See Fig. 11. When the fluorescent ballast is included in the channel the faceboard should be seven to eight inches deep. However, when functional light levels* are required and two rows of tubes are used, an eight-inch faceboard is essential. See Fig. 12. When a wood strip is fastened to the ceiling, as a means of attaching the cornice or to avoid light leaks, *and the fluorescent channel is mounted thereon*, the depth of the faceboard needs to be increased by the thickness of the wood strip in order for the tubes to be adequately shielded. See Fig. 13.

(2) In rooms with very high ceilings a cornice of greater depth is needed to shield the light sources from view. In some situations louvers or translucent glass or plastic shielding across the bottom of the cornice may be required to prevent viewing of the tubes from certain angles and to serve the decorative purpose of giving the cornice a finished appearance.

(3) Light leaks between the ceiling and the top of the faceboard can also be avoided by: (a) using a decoratively appropriate molding on the room side of the faceboard, or (b) attaching a strip of white felt to the top edge of the faceboard to act as a cushion filler when the faceboard is mounted on the ceiling.

FLUORESCENT WALL BRACKETS

Fluorescent wall brackets consist of channel strip and fluorescent tube or tubes shielded either by an opaque or a luminous shielding element. Fluorescent wall brackets may be used on a windowless wall to achieve lighting balance within an interior. Brackets mounted with bottom of the faceboard about 65 inches above the floor can be used to light lounge furniture, dining tables, etc. (Figs. 16 and 17). In shorter lengths, these brackets mounted at a lower position may be used to provide illumination at desks, beds, or ranges. See Figs. 18 and 19. The lighted wall bracket in these instances is different in design dimensions from the

*See footcandle chart, to be published in later installment.

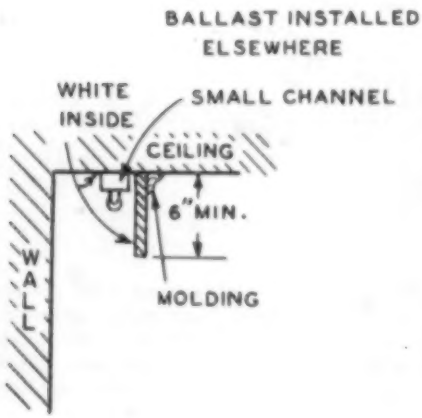
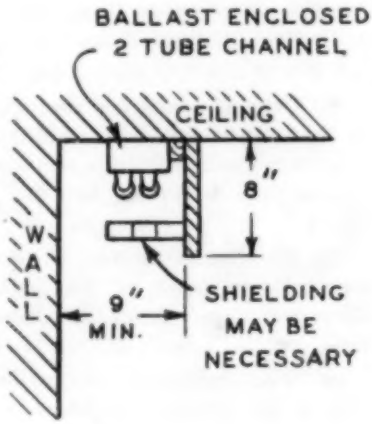


Figure 11 (left). If one row of small wiring channel is used (lumiline incandescent or fluorescent tube with ballasts installed elsewhere) the depth of the cornice board may be reduced to a *minimum* of six inches.

Figure 12 (right). When two rows of tubes are used to provide more light, an eight-inch cornice board is essential.



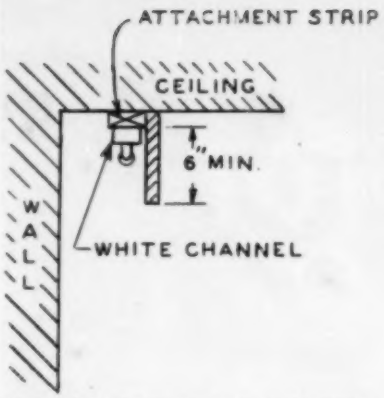


Figure 13. When a strip is fastened to the ceiling, as a means of attaching the cornice or to avoid light leaks, and the fluorescent channel is mounted thereon, the depth of the faceboard needs to be increased by the thickness of the strip in order to shield the tubes adequately.

Figure 14. This 28-foot cornice is arc-shaped to fit curved window wall. Shielding board depth is six inches at ends and eight inches at center. Illumination is from seven 40-watt 48-inch-long fluorescent tubes. Architect, C. W. Sullivan. Interior Designer, J. Grueninger.

Figure 15. A continuous line of fluorescent tubes concealed behind tilted cornice board illuminates the book bindings.

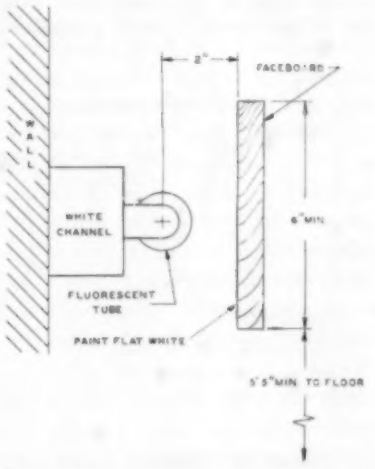


Figure 16. A fluorescent wall bracket of this design, with bottom of faceboard mounted about 65 inches above floor, can be used to light lounge furniture dining tables, etc.

Figure 17. A 10-foot shielding board on a 12-foot wood panelled recreation room wall conceals two 40-watt rapid start fluorescent tubes and gives about the same amount of light as a pair of table lamps. Use of the wall bracket eliminates moving lamps when cleaning or rearranging the furniture for activities.

Figure 18. Tilted faceboard shields 40-watt side-mounted fluorescent channel over desk. Light tube is positioned beneath two-inch opening (see Fig. 20) to allow some upward light to illuminate book titles and clock face and to give some indirect general room illumination.

Photograph by Gottscho-Schleisner

Figure 19. Wall-to-wall fluorescent wall bracket gives illumination for reading in bed and, with light-colored brick wall, provides general lighting for that end of room. The top surface of the bracket has been finished in glass to permit its use as a shelf for sculptures. Lighting Designer, Richard Kelly.

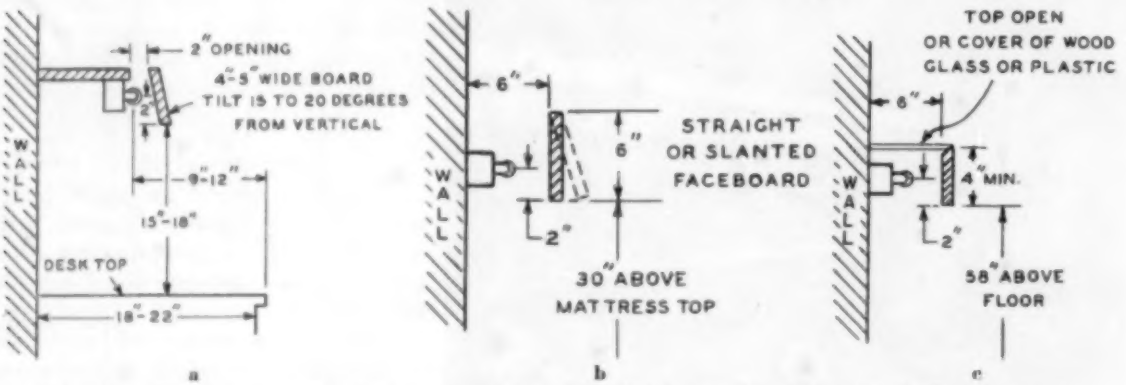


Figure 20. Fluorescent wall brackets positioned for useful lighting at (a) desks, (b) beds, (c) ranges.

Figure 21. Twin fluorescent wall brackets in twin girls' bedroom produce general lighting as well as lighting for closets and storage areas. Light is emitted upward from open top and diffused downward through a shielding panel. Interior Designer, Marianne Willisch. Architects, t.. Fred Keek and William Keek. Photograph by Hedrich-Blessing.

Figure 22. Collection of family photographs on walls of bedroom hallway illuminated by valance-cove which also serves to provide the general illumination.

valance in that the light sources and channel are *centered* behind the faceboard, or located within two inches of the bottom edge. Fluorescent wall brackets used for utilitarian lighting are located in accordance with the seeing task and the furniture over which they are placed. Fig. 20 shows positions for brackets over desk, bed and range. If a wall bracket is so located that the light sources can be viewed from a standing or seated position or when entering or leaving the room, some type of shielding (glass, plastic or louvers) becomes essential across the top or bottom of the bracket or both. See Fig. 21.

Fluorescent wall brackets have become so popular that "packaged" units are now available including channel strip and a variety of faceboard designs and finishes. Some of these packaged units can be installed on a wall outlet box and others have a cord and plug for connection into a convenience outlet.

WALL LIGHTING—INCANDESCENT

Wall areas and draperies are sometimes lighted by a series of incandescent units which may be suspended, surface mounted or recessed in the ceiling. With these methods it is possible to obtain varying effects from uniformity to "scalloped" patterns. The choice of equipment, its spacing and light distribution is important in achieving either effect. The pattern of light and dark is regarded as interesting and attractive by some designers. Others prefer units which employ means to smooth out these variations in brightness.

There are several varieties of lighting units on the market which if spaced in or on the ceiling and out from the wall in accordance with the fixture manufacturer's instructions, will "wash" a wall fairly uniformly with light. These units are designed with reflectors or lenses or both to use standard incandescent bulbs or reflector bulbs of the R, PAR and T types having built-in reflector control. If units are recessed in or mounted on the ceiling closer to the wall or spaced farther apart than is recommended in the fixture manufacturer's specifications, the resultant wall lighting will not be uniform.

The methods used for the resultant lighting effect are a question of personal choice. Figs. 23 through 29 and many of those shown in the section "Light-

Figure 23. Series of pendant perforated metal fixtures illuminate the wall, accenting the color and texture of the bricks.

Figure 24. Curtained window-wall accented by a series of surface mounted swivel type fixtures.

Figure 25. Wall illumination from three 150-watt "wall washing" units recessed in ceiling. For even lighting from such units it is important to follow the manufacturer's suggested spacing and distance out from wall. In addition, three pin-hole downlights illuminate dining table. Architect, Robert Carson.

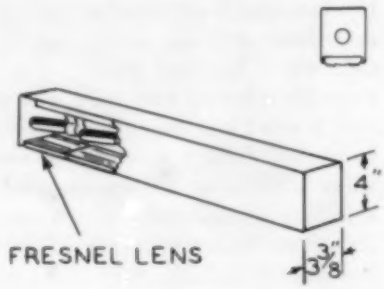


Figure 26. A structural beam on the ceiling has been built out to conceal an incandescent lens strip designed to produce an even wash of light down wall. Interior Designer, Beverly Reitz.

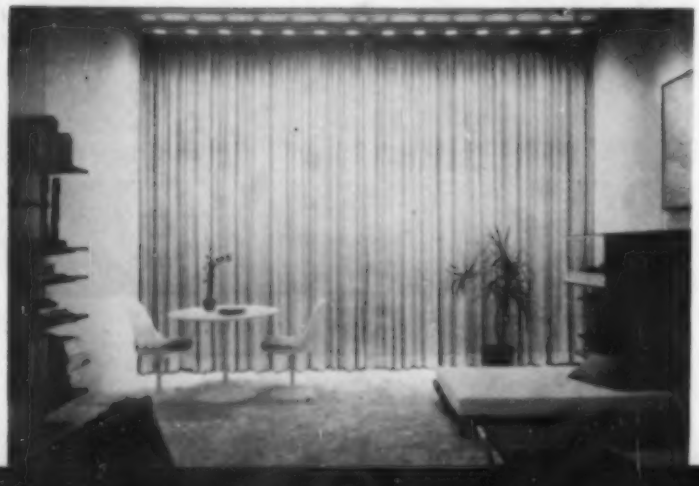


Figure 27. Draperies and adjacent area of dining and sleeping area in a bachelor's apartment lighted by 75-watt PAR-38 lamps with spread lenses mounted 12 inches apart, 13 inches out from face of drapery. These are dimmer-controlled. Interior Designer, Virginia Whitmore Kelly. Photograph by Alexandre Georges.

Figure 28. Painting illuminated by incandescent lens strip similar to one in Fig. 26, but concealed here in bronze box attached to ceiling. Similar directional strip concealed behind a cornice lights draperies, but effect is softened by sheer silk gauze over-curtain in front of lens strip. All lighting (including downlights in box over table and indirect lighting concealed in bronze "tubes" dropped from ceiling) is independently dimmer-controlled. Architect, Philip Johnson; Fabrics Designer, Marie Nichols; Lighting Designer, Richard Kelly.

Figure 29. Draperies illuminated by a continuous line of lumiline incandescent bulbs concealed behind the traditional detailed cornice. The lighting in this living room is dimmer-controlled for a wide variety of moods. Interior Designer, Beverly Reitz.

ed Interiors"* are examples of the variety of units and methods for using incandescent sources for wall lighting.

LIGHTING BEHIND CURTAINS

In rooms with little or no daylight, or where the sensation of daytime is desired in the evening, light may be installed *behind* translucent curtains. Incandescent or fluorescent light sources may be used. Because of their narrow diameter, variety of length, higher efficiency and less heat, fluorescent tubes are often preferred.

Installations may consist of continuous rows of light sources installed vertically along each side of a narrow window (see Fig. 30), or a lens strip located as shown in Fig. 27. Consideration should be given to the outside appearance of the lighted installation to be certain that appropriate shielding is provided so that the light sources are concealed from outdoor viewing positions.

*To be published in later installment.

Figure 30. The effect of sunshine coming in the windows is created by two 30-watt fluorescent tubes set end-to-end vertically behind metal shields in front of the venetian blinds but behind the draperies. The ballasts are installed in the hollow space beneath the windows. Lighting Designer, Thomas Smith Kelly.

Figure 31. Traditional living room illuminated by coves installed on all four walls 15 inches below the ceiling.

Cove Lighting

Cove lighting of simplified contemporary design has increased in popularity, especially in homes with high ceilings where the structural design has been planned to give a feeling of height and spaciousness. Cove lighting can help fulfill today's desire for an atmosphere of openness and airiness.

The conventional cove is a trough-shaped architectural element usually mounted on the upper wall of a room. See Fig. 31. In houses of contemporary design the trough-shaped shielding is sometimes attached to exposed beams or other structural members (see Fig. 32). Wherever used a cove provides concealment for light sources used to achieve indirect lighting.

The effect of lightng from a cove alone is soft and pleasant but it tends to be rather flat and monotonous. A room with cove lighting needs other lighting treatments to add the interest produced by shadows, highlights and sparkle. Cove lighting is an effective "background" for portable lamps and for direct lighting from ceiling-recessed or ceiling-attached downlighting units. Together they produce the soft, general lighting and the accent lighting that complement each other.

Most coves are made from wood, plaster or metal. Plastic or glass may be introduced for a luminous effect. The exterior design of the cove should be esthetically appropriate for the room scale, proportions and decoration. Usually, the cove design repeats or reflects other structural design elements in the room such as woodwork trim in window framing, cornice, baseboard or fireplace.

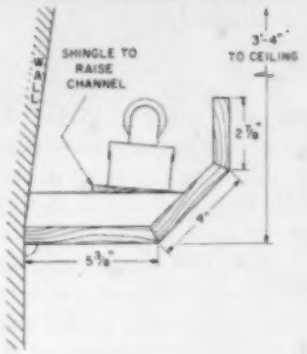
A properly designed residential cove provides a moderate level of light reflected from the upper walls and ceiling. Coves may be on all four walls of a room, although their use on opposite walls is generally effective. Pitched, slanted or multi-planed ceilings frequently lend themselves to a cove treatment along one side of a room. See Fig. 33. To obtain an architectural balance the cove should be at about the same level as the height of the opposite wall.

Effective cove lighting will depend upon the observance of proven critical dimensions and the following recommendations:

(1) The top of the light source should be *at least* 12 inches below the ceiling; increasing this minimum distance will improve the distribution of light across the ceiling and throughout the room.

Figure 32. Cove built along one side of ventilating duct in sloped ceiling interior. Six-inch faceboard tilted at about 30 degrees shields 40-watt fluorescent tubes located directly behind it, about 14 inches out from wall. Interior designer, Sue Dougles. Architect, J. Stickter. Photograph by Will Thompson.

Figure 33. Cove along high wall in room with pitched ceiling is installed at about same level as height of opposite wall.



(2) The center of the light source should be located at least 4½ inches from the wall, to prevent excessive wall brightness.

(3) The position of the cove in the room, the position of the light sources in the cove, and the dimensions of the cove itself should be carefully coordinated:

(a) so that the tubes or bulbs and the channel are completely shielded from any normal viewing position within the room or adjoining areas,

(b) if maximum uniformity of ceiling brightness is desired, so that the cove lip does not shield any part of source from any part of the ceiling.

In terms of a diagram (Fig. 35), this means:

(a) draw a line (A) from the upper surface of the source (or the channel, whichever is higher) to standing eye height at the farthest point from which the cove is visible (68 inches allows for the height of an above average tall man) and

(b) then draw a line (B) from the lower sur-

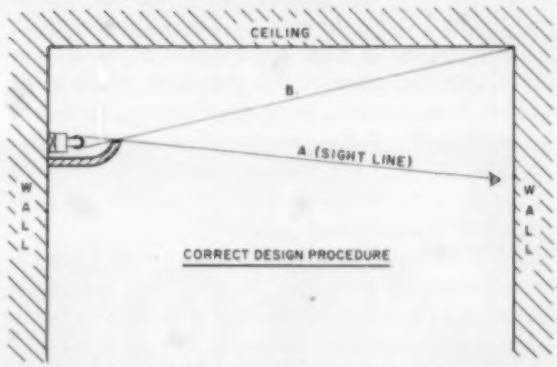
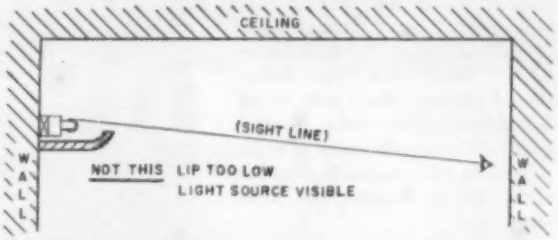
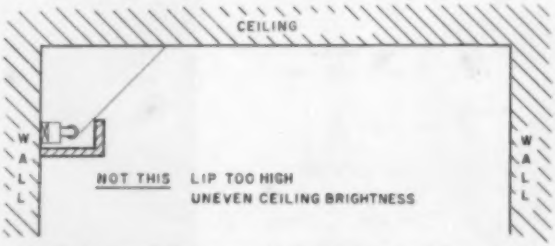


Figure 35. (a) Ideal location of upper edge of cove lip is determined by the intersection of line A (drawn tangent to the upper surface of light source from eye height at most distant point from which cove will be viewed) and line B (tangent to bottom surface of light source from juncture of ceiling and wall across room).



(b) If the cove lip is lower than shown in (a), the light source will be visible from distant locations.



(c) If the cove lip is too high, it will produce a sharp cut-off of light on the ceiling close to the wall.

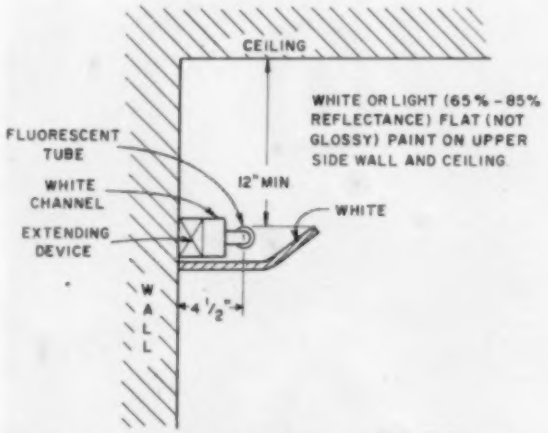


Figure 34. Effective cove lighting depends upon the observance of these critical dimensions.

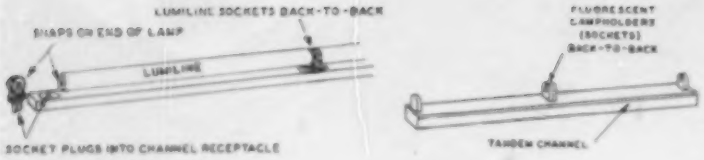


Figure 36. To assure a continuous band of light on walls and ceiling without dark spaces between tubes, the lampholders (sockets) should be butted back-to-back.

face of the source to the junction of wall and ceiling across the room. The upper edge of the cove lip should be at the point where these two lines cross.

(4) The lampholders (sockets) of the fluorescent tubes and incandescent lumilines should be butted back-to-back, or overlapped if space permits, to assure continuous light on the walls and ceiling without dark spaces between tubes. See Fig. 36.

(5) The inside of the cove, the channel, and the lampholders (sockets) should be white. The ceiling and the wall above the cove should be a matte finish paint or paper of high reflectance (65 to 85 per cent). (Glossy paints or papers and rough swirl plaster treatments on ceilings or side walls should be avoided. The former produce high-brightness reflections of the light sources, and the latter may cause distorting shadows that tend to give the ceiling a soiled appearance.)

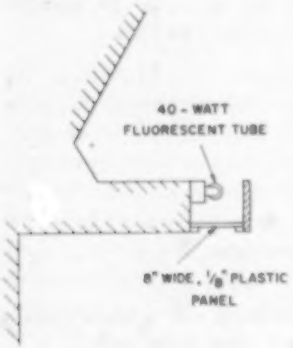
(6) Residential coves may be designed to use silvered incandescent bulbs. However, the use of external reflectors and/or lenses of appropriate contour and finish used with non-silvered bulbs will make it possible to direct the light away from the wall and extend it more uniformly across the ceiling.

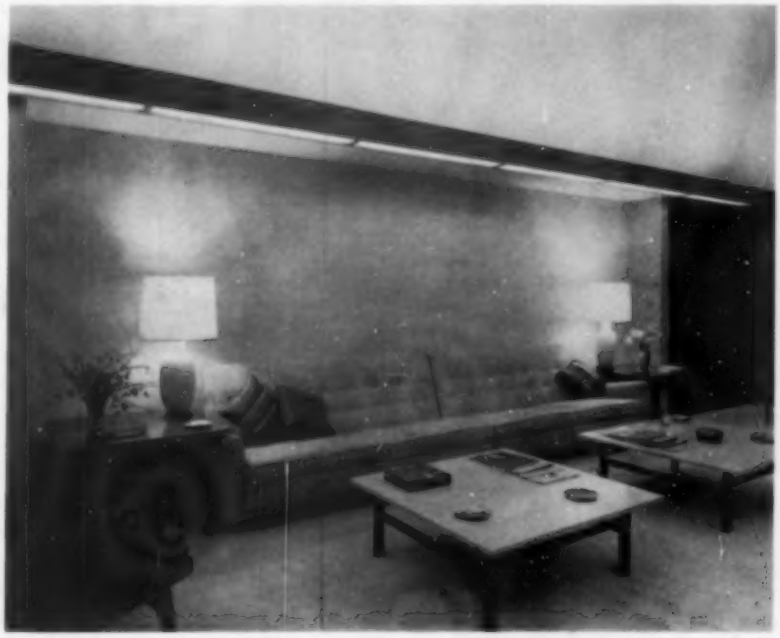
The variety of fluorescent tubes available expands the possibilities for cove lighting since their light efficiency, variety of lengths and small diameters make them suitable for this purpose from both appearance and lighting considerations. Different lengths of tubes may be used in a single cove, but where possible, it is best to use tubes of the same diameter and of the same color quality; otherwise, a variation in wall brightness may be apparent. If slimline tubes are used they should all be operated at the same current (milliamperes).

The size and shape of incandescent lumiline tubes make them applicable in coves. Their electrical consumption (watts) per foot of tube is approximately three times that of fluorescent tubes. For example, one incandescent lumiline tube 18 inches long consumes 60 watts while a 15-watt 18-inch fluorescent tube and ballast consume approximately 19 watts. The amount of light per foot, however, is about the same in each case. The simplicity of installation and the minimum dimensions of the wiring channel sometimes make lumilines a desirable light source for cove lighting.

Today, dimming equipment for both incandescent and fluorescent light sources adds flexibility to the lighting level obtainable from any given cove.

Figure 37. Translucent plastic bottom of 29-foot cove is 7½ feet above floor. Cove has seven 40-watt rapid-start fluorescent tubes, about two feet below sloped ceiling. Since sofa is set into 2-foot 4-inch niche, fluorescent tubes are over front of sofa, providing 10 footcandles. Architects, W. D. Riddle and Carl Droppers.





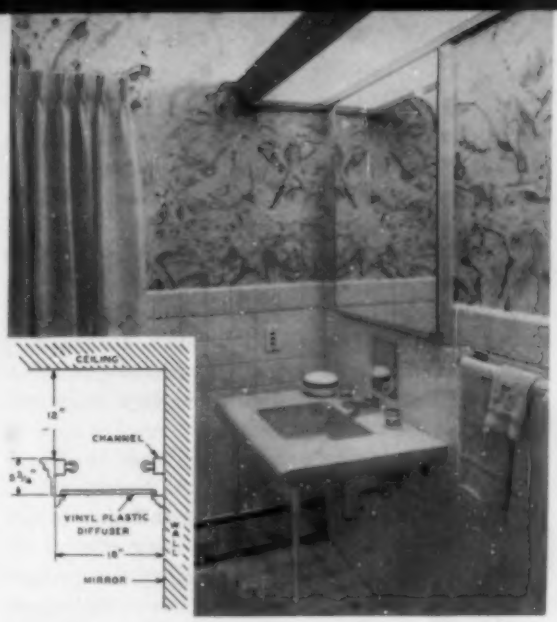
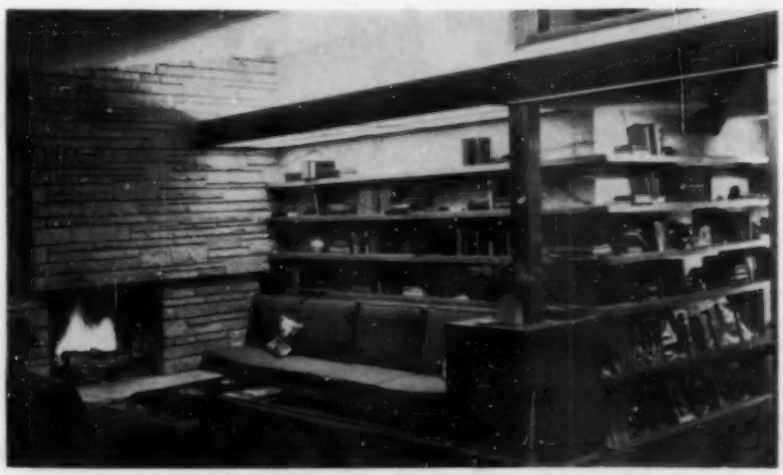


Figure 38. This installation may be described as an open-top soffit or a wide cove with luminous panel. The technique provides indirect general room lighting and diffused downward light for shaving or make-up.

Photo: Maynard Parker, courtesy House Beautiful Magazine

Figure 39. One-wall cove reflects light into bedroom, accents decorative accessories. Six-inch cove faceboard is mounted 8 inches out from wall. Architect, H. H. Harris; interior designer, William P. McFadden.

Figure 40. Cove below the sloped ceiling in this entrance hallway conceals four 40-watt dimmer-controlled fluorescent tubes. Note also the pendant fixture hanging in the center of the cove and the two downlights recessed in the ceiling over the console at right. Architect, Clifford N. Wright; interior designer, Van Riper Studios.



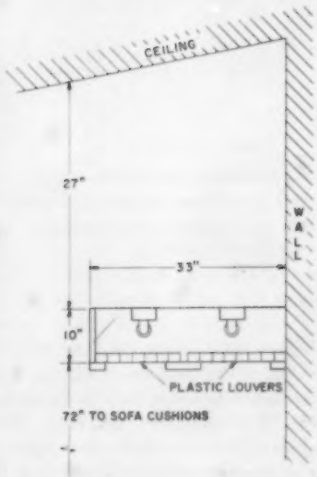


Figure 41. Direct-indirect cove with plastic louvers uses 40-watt fluorescent tubes.

Figure 42. For personal grooming, large soffit-mounted fixture produces diffused illumination on the face. Light-colored counter tops are essential for reflecting light upward under chin. Note recessed vapor-proof light in shower. Photo, *Living for Young Homemakers.*

Recessed Lighting

Recessed lighting as discussed here includes both built-in fixtures with surface panels of relatively large area for diffuse illumination and fixtures with smaller openings which provide more concentrated illumination. Properly designed and installed, recessed fixtures of either type provide functional and decorative illumination—general or local. Generally, accent lighting for decorative effect is accomplished by the use of the concentrating types which have various means of beam control.

When recessed ceiling units are used for general room lighting they may be unsatisfactory and disappointing to those who use them in a desire to eliminate the more traditional ceiling-attached or suspended luminaires. A satisfactory installation requires attention to several factors:

(1) Use of enough fixtures to produce satisfactory light distribution, particularly in a large area or in a room with a low ceiling.

(2) Use of a sufficiently large fixture or enough light sources to produce functional light levels.

(3) Proper selection and/or installation of fixtures to produce the intended lighting effect.

(4) Use of a light-colored ceiling to prevent annoying brightness difference between the fixture and its background.

(5) Use of reflected and/or upward light from other sources in the room to reduce the brightness difference between the recessed lighting unit and the ceiling, unless the recessed lighting unit occupies a large extent of the ceiling area.

(6) Use of light-colored matte surfaces within the room to reflect the light and to prevent glare redirected from highly polished objects.

Small units with panel surfaces of approximately 50 to 144 square inches are appropriate when used singly or in multiple to produce general lighting of small areas such as entrances, vestibules, halls and stairs. There are also many places where one or more recessed boxes of small dimension may be used to provide local lighting over a rather limited area: steps, sink areas, card tables, niches, stall showers, or for decorative accent lighting. Recessed lighting haphazardly installed without knowledge of furniture placement or activity patterns will seldom, if ever, prove successful.

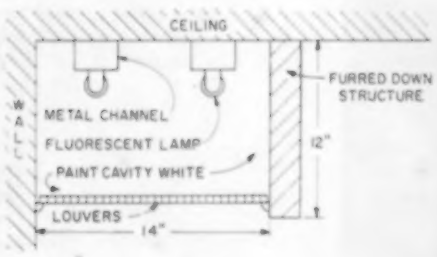


Figure 43. Four 40-watt fluorescent tubes shielded by louvers combine with light reflectance counter tops to provide an average of 75 footcandles on face. Note recessed shower light, pin-hole downlight over planter and fluorescent wall bracket in bedroom, all reflected in the mirror.

LUMINOUS PANELS

Recessed fixtures may be round, square or rectangular metal boxes set into the ceiling with a covering shielding panel flush with the ceiling. The interior finish of recessed boxes should be of high reflectance for efficiency. Some are equipped with polished metal reflectors to increase light output.

A soffit may be built specifically to accommodate a lighting fixture as shown in Fig. 42. In new construction, instead of recessing a fixture, the light sources are sometimes mounted between joists or in a hollow furred sector and shielded by translucent or louvered panels. See Fig. 43.

The shielding of recessed units, while concealing the light source or sources from all normal viewing angles, should permit the emission of light in the desired direction. The shielding medium may be a panel of glass or plastic, or louvers of metal, plastic or wood. Lens plates may be selected to spread the light, concentrate it, or redirect it at a specified angle. Recessed units of good design with proper spacing of light sources above a diffuse shielding medium will not reveal a "hot spot" from incandescent bulbs or a marked "streak" of brightness from fluorescent tubes. Units where the shielding panels have a noticeably spotty appearance when lighted should be avoided.

In designing a recessed installation similar to that in Fig. 45, two dimensions are significant: (1) the spacing (distance) between light sources and (2) the spacing between light sources and the shielding medium. As a guide, distance between tube or bulb centers should not be more than 1½ to 2 times distance from centers to diffuser (see Fig. 68). Where cavity space is limited, light sources may be within 3 inches of panel, but unless highly diffusing material is used, there will be great brightness variations. Minimum distances of 6 to 8 inches will give greater uniformity.

Figure 44. In this corner of a family room, a large low brightness fixture with two 40-watt tubes shielded by configurated glass is mounted between ceiling joists. Large floor lamp uses 50/200/250-watt bulb. Architect, John Briggs; decorator, William Sewell.

Recessed units with large panels of low brightness if properly spaced and used in sufficient numbers will provide *general lighting* in kitchen, bathroom, bedroom, family or recreation room, and hall. Large panel units of low brightness may provide *local lighting* over specific locations such as dressing tables, bathroom mirrors, game tables, utility work centers, selected furniture groupings or the head of a bed. See Figs. 42, 44 and 45.

Figure 45. General illumination for this compact master bedroom and local light for reading in bed are provided by custom-built recessed fluorescent fixture which also effectively highlights the scenic wallpaper. Four 40-watt tubes are staggered across the ten-foot length of the 20-inch wide by 12¼-inch deep recess.

Figure 46. Louvered downlights highlight the drapery which reflects light into this dining corner to balance a 12-inch square recessed fixture located over the table. Photo courtesy of *Living for Young Homemakers.*

◄ Figure 47 (left). Three louvered recessed downlights (with 75-watt R30 floodlight bulbs) located 30 inches apart, illuminate light-colored counters, Monel metal sink. Units are positioned off center to avoid reflection from metal sink into eyes of person before it. White curtains, light surfaces soften what would be harsh downlighting if room had darker finishes. Architect, Hugh Stubbins.

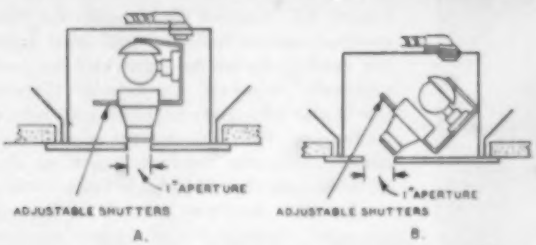


Figure 48. Two types of recessed pin-hole downlights with adjustable shutters to shape beam pattern. (A) aperture in center of plate for direct downlighting; (B) aperture off-center to project light at an angle.

Figure 49. Accent lighting on table top is from 100-watt, 1½-inch aperture pin-hole spot recessed in ceiling. Fixture has lens system and adjustable baffles so light beam can be adjusted to cover only table top (see Fig. 48A). Illuminated window and wall areas at left (not shown) provide backdrop for this dramatic lighting.

DOWNLIGHTS

Downlighting has many uses in today's residential interiors: for decorative accent lighting of specific objects—pictures, floral arrangements, murals, stone or textured surfaces and art objects; for functional local lighting at pianos, sewing and other limited work centers; for lighting wall or drapery surfaces for reflected illumination; and when used in multiple, for general lighting. See Fig. 46.

While the units available are as varied as the uses to which they may be put, one form of recessed downlight for residential application is the round metal can with an aperture of one to 6 inches. Such units with apertures of 3 to 6 inches, sometimes called "high-hats," are designed for a standard incandescent bulb in a reflector or an incandescent reflector (R) or projector bulb (PAR). See Fig. 47. The latter two have comparatively long life and combine reflector and light source in one unit. This has the effect of eliminating the need for cleaning the units when the bulbs burn out.

There are so-called "pin-hole" downlights with apertures of 1 to 2½ inches, some of which are designed with an optical system of light control. Some of these are equipped with adjustable shutters, making it possible to shape the beam precisely—square, round or rectangular—to the object to be lighted. Some units have the aperture centered for projecting light directly downward, others have the aperture off-center for projecting light at an angle to illuminate paintings or art objects. See Fig. 48. Some of these units use special bulbs with high light output and relatively short life; therefore, they require more frequent maintenance for bulb replacement and for the adjustment of the optical system to obtain the desired results. See Figs. 49, 50 and 51.

Still other types of recessed units have been designed to "wash" walls with light. (See Window and Wall Lighting, page 529.) For satisfactory results, it is essential that all units of this type be installed in accordance with the manufacturer's

Figure 50 (above). Natural, interesting shadows are produced by strong directional light beam from ceiling-recessed pin-hole spot. Against comparatively low level of surrounding illumination, white statue stands out before gold background. Skillful adjustment of fixture baffles confines accenting light to figure. Architect, Edward Stone; lighting, Thomas Smith Kelly.

Figure 51 (right). Accent lighting and irregular brightness patterns were results sought in this living room. Three of the four pin-hole spots used to create these effects are visible; fourth unit highlights cocktail table. In each recessed unit aperture in bottom plate and lighting device above it were positioned to direct light on selected objects—cocktail table, oil painting, books. Shutters were adjusted to produce exact shape and size of light pattern desired. On painting, for example, shutters were adjusted so that only canvas and narrow mat are illuminated with no spill light on gold frame. Architect, Emil A. Schmidlin; architectural designer, Ellis Leigh; lighting designer, Richard Kelly.

Figure 52. Ten louvered recessed "high-hat" units on three-foot centers provide general illumination in this kitchen. Each unit contains one 75-watt R30 flood bulb. In addition, there is continuous fluorescent lighting beneath all the wall cabinets.

Figure 53. The recessed downlights over the table and hearth area in this remodelled kitchen-dining room are supplemented by cornice lighting.

instructions for distance out from the wall and spacing between units.

A number of recessed downlights may be used to provide acceptable general lighting if: (1) they are used in sufficient number to produce an overlapping of the light beams, and (2) the floor, wall and large pieces of upholstered furniture are of high reflectance (see Color Reflectance Chart*) so that light is reflected back to the ceiling to create a visually comfortable environment. See Fig. 52. As a rule, recessed downlights are most effective when used in combination with other lighting which produces some light on the walls and on the ceiling of the room. This may be accomplished by the use of one or more of a variety of lighting techniques. See Fig. 53.

Shielding

In residential interiors of average proportion and with low ceilings, the shielding of the bulbs in recessed downlights is essential if the lighting is to be comfortable. The visible inside of the metal housing should be finished in a matte black or dark grey and equipped with baffles, louvers, or a lens. See Fig. 54. If the housing is not equipped with a shielding device, the distance between the ceiling and the light source should be approximately 5 inches to prevent visibility of the light source from normal viewing angles. If there is glare when viewing the bright inner surface of the unit or the light source, or if any portion of the bulb protrudes below the ceiling, the fixture is unacceptable for residential use.

The trim on recessed fixtures may be flush with or overlapping the ceiling plaster, or dropped below the ceiling line. Usually the trim is a metal flange. A more dramatic touch is provided by a flange of decorated glass which becomes luminous from the spill light from the lens. In some downlights the risers of the lenses or louvers are treated

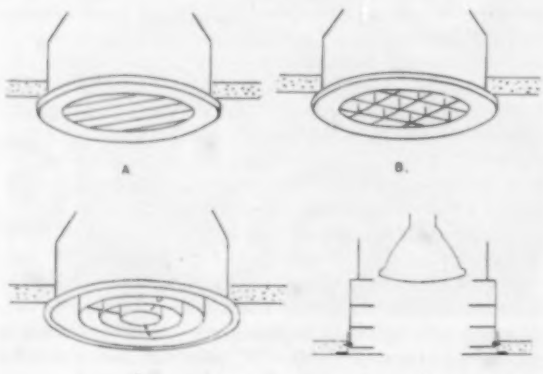


Figure 54. Four types of shielding for recessed downlights: (A) parallel louvers, (B) egg-crate louvers, (C) concentric ring louvers, (D) series of ring baffles.

*Not published here. To appear in reprint.

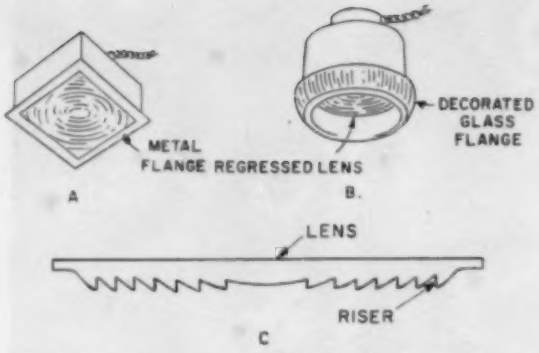


Figure 55. (A) Recessed unit with flush lens and metal flange trim, usually white, aluminum or brass; (B) downlight with regressed lens and decorated glass flange; (C) Fresnel lens enlarged. Risers may be painted in color to give the lens a decorative appearance.

with color to produce a flattering tint of light. See Fig. 55.

Recessed fixtures designed so that the light source can be rotated and angled within the fixed housing to direct the light where desired have been discussed previously. Other types conceal the bulb in a metal sphere which projects below the ceiling level and can be rotated to put the light in the desired location. These units are sometimes referred to as "eye-balls." Louvers or lenses may add further shielding of the bulb and control of the light beam. See Figs. 56 and 57.

Space Allowance.

Since recessed lighting of any type requires space above the ceiling, which may vary from approximately 5 to 12 inches, it is essential that the available height be known before planning a recessed lighting installation. It is also mandatory to know the location of the joists when long recessed fixtures are being considered. It is obvious, therefore, that recessed lighting is more practically considered when a home is in the blueprint stage. This does not mean, however, that some types of recessed lighting cannot be installed when relighting an existing home.

Maintenance

Some recessed units may be relamped and cleaned directly through the bottom opening; others have a hinged or removable ceiling plate; still others require maintenance from the top of the fixture, which means that the unit must be accessible from the floor above or from open attic or crawl space.

Figure 56 (left). Window alcove is lighted by three 75-watt R30 (reflector) bulbs in recessed fixtures with wide polished brass flanges, concentric ring louvers painted pink. Music score is lighted by semi-recessed adjustable "eyeball" unit mounted 24 inches out from music. Fixture housing is matte white; louvered opening prevents direct viewing of 150-watt R40 floodlight from oblique angles.

Figure 57 (below). Single adjustable semi-recessed "eyeball" fixture for decorative accent on fireplace wall.

Figure 58. General illumination of 45 footcandles is provided by rows of 40-watt fluorescent tubes on 24-inch centers in an 18-inch deep cavity. The shielding is 24-inch square formed plastic panels.

Figure 59. This wall-to-wall luminous ceiling illuminates a very large bathroom. Note in the mirror the reflection of the vaporproof light recessed over the shower. Architect, William R. Stephenson, AIA; Interior Designer, Helen Conway; Lighting Designer, E. W. Commery.

Luminous Ceilings and Walls

The desire of architects to create new concepts of enclosed space, with emphasis upon the clean cut, uncluttered lines of structure, has led to the development of lighting methods that are in harmony with this architectural thinking. Ceiling and wall planes offer the most logical locations for luminous area lighting installations. The feeling of flat surfaces can be retained by concealing the required light sources behind panel units or sheets of diffusing or louvered shielding materials. With this lighting method the structural concept is not altered by the introduction of the lighting installation. The space, however, seems larger, more airy and far less confining.

Luminous ceilings when unlighted will retain the feeling of a flat structural ceiling surface. When lighted, they often simulate a skylight both in surface appearance and lighting results.

Luminous walls can be designed to resemble solid wall construction when unlighted. When uniformly lighted, they may retain this solid wall feeling, or they may be designed to use gradations and variations in light distribution, brightness and color to produce random patterns or give emphasis to mural-type surface design treatments. The resultant lighting effect will depend upon the design plan of the installation.

In either case, ceilings or walls, dimming can be used to change brightness levels and resultant room illumination. Switches can be used to shift from uniform to non-uniform brightness patterns and to change the illumination level.

SUGGESTED APPLICATIONS

Luminous ceilings may be designed for high or low levels of illumination, with residential installations generally in the range of 30 to 100 footcandles. Luminous ceilings are most commonly used in utilitarian areas such as kitchens, laundries, bath and bath-dressing rooms. See Figs. 58 and 59.

This type of ceiling installation also is suitable for lighting family or recreational rooms, to provide equal seeing conditions for all members of a group participating in either games or hobbies. In a recreation room it is often desirable to provide for variations in light level because of the numerous varied activities ranging from conversation, TV viewing, or hi-fi listening, which are enjoyed by most people under low levels, to the highly active pastimes—children's games, ping pong—which are best served by high levels of illumination. Very exacting eye work, such as sewing, wood carving and jewelry making will require additional local illumination which may be provided by the use of portable or wall-attached equipment. Combination of the two, general and local lighting, in these cases will create seeing conditions that aid the worker in achieving satisfactory results.

Figure 60. Brass T-bars support opal plastic panels which diffuse the light from eight rows of four 40-watt, dimmer-controlled fluorescent tubes on 10-inch centers in a 10-inch deep cavity. Oriental art objects are viewed against a similar luminous wall installation. Interior design, Washsman Associates, Inc.

Figure 61. In this 7-foot 4-inch by 16-foot 4-inch foyer three 96-inch slimline fluorescent tubes are mounted in an 18-inch cavity on 24-inch centers above 24-inch formed plastic squares. Three lighting levels (18, 27 and 45 footcandles) are provided by combination switching; one switch controls the center lamp, another controls the two outside lamps.

Luminous ceilings providing low levels of general lighting can be installed in other residential areas such as living rooms, dining rooms or foyers. In these areas decoration is more formalized and the desire is to create an atmosphere, or induce a mood suitable to a specific occasion. Therefore, flexibility in control for the adjustment of light level and brightness is always a requirement. See Figs. 60 and 61.

Luminous wall installations may be designed for functional use, or as purely decorative elements, or as a pleasing combination of the two. When intended for functional use, they are planned to simulate a lighting effect similar to that from a sheer-curtained glass window wall. Furnishings may then be arranged so that advantage is taken of this lighting for local application in much the same way as is done with daylighting. See Fig. 62.

Luminous wall installations can be used to aid in providing general lighting, although to achieve a balanced lighting effect, other elements will be required, such as valance, cornice or fluorescent wall bracket designs on other walls. The daytime appearance of an interior with a glass wall can be pleasingly balanced in light distribution by making the opposite wall luminous. By night, the curtained glass wall may be lighted by a cornice or by a valance.

In the purely decorative applications the wall becomes a luminous area to be viewed objectively for its contribution to the decorative interest within the space. It is not intended as a method for producing or, in many cases, even contributing to the lighting for seeing activities. Decorative installations may be used to create vista interest as when viewed through a living room entrance or similar opening as shown in Fig. 63.

The selection of installation type will depend upon the need or the effect desired. Generally the functional type is used in interiors where living activities will benefit by such an installation. The possibility for combination of the functional with the decorative is always attainable by pre-planning the placement of selected light sources for separate circuits, controlled for variations in light distribution, color, pattern and brightness.

Most luminous wall installations require dimmer control to coordinate the brightness and light levels to other lighting within the space, for adjustment to surrounding reflectances, as well as for variations appropriate to activities.

PLANNING FOR INSTALLATION

Luminous ceilings may be pre-planned for new construction so that when installed they are on a level with the accepted ceiling height for the entire structure as shown in Fig. 64. In existing structures the luminous ceiling may be superimposed by

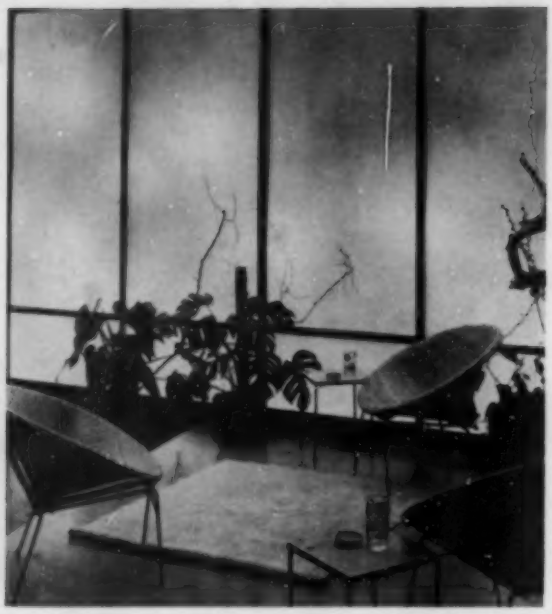


Figure 62. Illustration of the mechanics (left) and finished appearance (right) of a large luminous wall installation. Within the 12-inch deep, 9-foot long white finished cavity, vertical channels alternately accommodate fluorescent and incandescent light sources. Horizontal fluorescent tubes, not visible, are positioned at top and bottom as shown in Fig. 70. A combination of dimmers and multiple switches makes possible variations in lighting levels and combinations of brightness patterns and color effects. The plastic diffusing panels are mounted in wood frames that glide across a ceiling track for ease of maintenance.

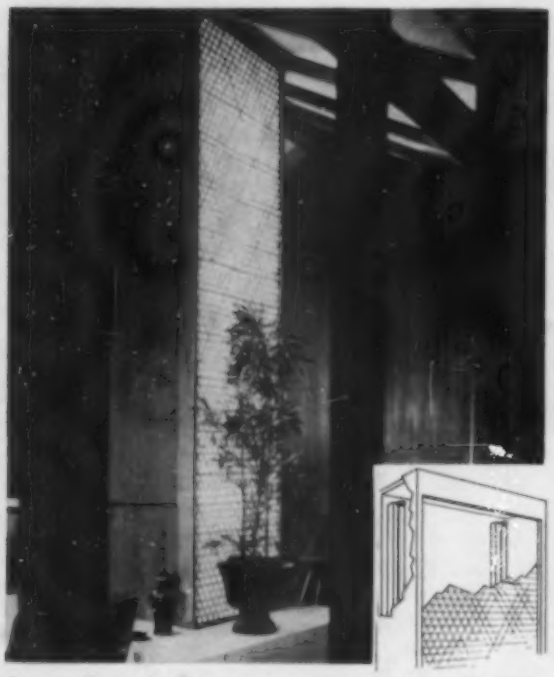


Figure 63. A decorative column of light in an entrance foyer. In the 6-inch deep cavity there are two rows of 30-watt rapid-start tubes on each side extending from top to bottom. The 30-inch wide diffusing panel is of opal plastic with an overlay of Oriental grass weave. Interior designer, C. Eugene Stephenson. Lighting designer, E. W. Commery.

Figure 64. Entrance hallway illuminated by three 40-watt fluorescent tubes spaced two feet apart above lightweight corrugated vinyl plastic (4 feet by 6 feet). Added interest is provided by three 75-watt R30 floodlights in louvered eye-ball fixtures. These floodlights highlight the planter and emphasize the textures of the stone and paneled walls.

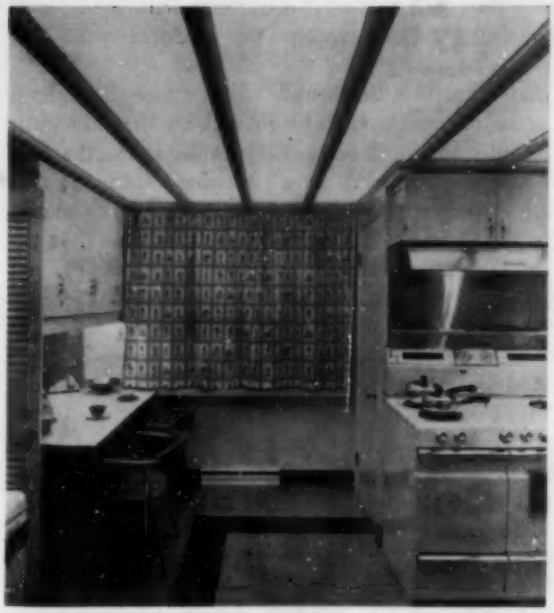


Figure 65. In this remodelled kitchen fluorescent tubes on 16-inch centers were installed on the 9-foot ceiling directly over the decorative wood cross supports which hold the corrugated plastic panels 12 inches below the original ceiling. The pass-through snack counter is lighted by a shielded fluorescent tube centered under the cabinets.

suspension from the present ceiling. See Fig. 65. In these cases, checking of the space available for cavity depth should be based on the National Building Code allowance of 7-foot 6-inch minimum for a finished ceiling height. All usable space above this dimension can be considered for installation.

Luminous walls may also be pre-planned for new construction. When this is done, this element can be used to act as a sound insulator or space-divider, or to give a new appearance to locations that might not have or require windows, but that need to be lighted.

In existing structures luminous walls can often be used to alter or correct poorly proportioned space. Unless the interior is very small, the deduction of floor space needed for installation will hardly be noticed. The lighting result achieved will often more than compensate for this loss of space.

Installations of luminous ceilings and walls can be planned to resemble each other closely or, with variations in lamp placement and surface treatment, to appear to be quite different. There are many installation requirements common to both.

I. Each requires a cavity or plenum for housing the light sources and auxiliary equipment. The length and width of the cavity may be governed by the architecture and interior design.

Depth of cavity for either ceiling or wall installations may vary. However, a cavity 12 inches deep is the most feasible and practical for residential applications. With a 12-inch depth good utilization can be made of readily-available electrical equipment and shielding materials.

II. For good diffusion all surfaces of the cavity should be of high reflectance (75 to 85 per cent) and matte texture. The simplest and best method is to give the entire cavity several coats of a good grade of flat white paint.

White finish channel strip for fluorescent tubes and white lampholders or sockets for both fluorescent and incandescent sources are also needed for satisfactory reflection and diffusion. As a rule, any other materials within the cavity such as pipes, beams, joists, metal raceways and conduit should be treated with a white finish. See Fig. 62 (left).

Dark finishes, silver or aluminum paints, and dark composition sockets or lampholders will absorb light and reduce the brightness of the shielding material. This lower brightness will cause the shielding material to appear dull and lifeless or spotty and smudged depending upon the extent of the dark area within the cavity. Therefore, careful attention should be given to *all* surfaces and materials within the cavity so that the finished results will not be marred because of oversight of any small but important details.

III. An example of a 12-inch cavity within a definite space size is shown in Fig. 66 as a guide for planning luminous ceiling installations. It may

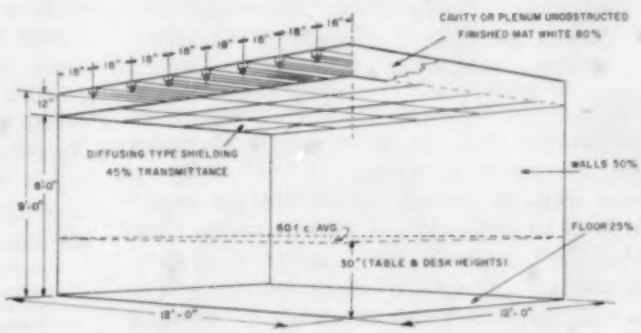


Figure 66. A light level of 60 footcandles is produced by seven rows of three 40-watt fluorescent tubes on 18-inch centers. Light distribution and surface brightness are approximately uniform.

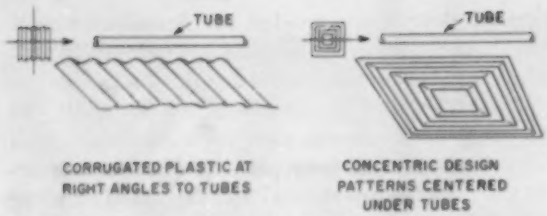


Figure 67. Methods for reducing non-uniform appearance of surface brightness.

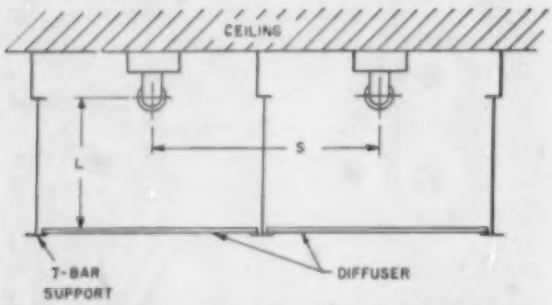


Figure 68. Cross section of a portion of a luminous ceiling which was designed to produce uniform brightness. The distance *S* (distance between the tube centers) should not exceed 1½ to 2 times *L* (the distance from the tube center to the luminous ceiling).

be noted that the same principles apply to luminous wall installations.

Room Size—12 by 12 feet
Walls—50 per cent reflectance; Floor—25 per cent reflectance
Structural Ceiling Height—9 feet
Cavity Depth—12 inches; Reflectance—80 per cent
Finished Ceiling Height—8 feet (distance from floor to luminous ceiling)
Light Sources—40-watt T-12 (48-inch) fluorescent improved-color type tubes, warm or cool
Number of Tubes—21 (7 rows of 3 tubes per row)
Distance Between Tube Centers—18 inches
Shielding Material—diffusing type, 45 per cent transmittance
Light Level Produced—*60 footcandles estimated* average, at a height of 30 inches (table or desk height)

The example above produced a light level of 60 footcandles with the tubes spaced 18 inches apart. Decreasing the number of tubes and positioning them on 24-inch centers will reduce the light level to approximately 45 footcandles. Positioning the tubes on 36-inch centers will produce an approximate level of 30 footcandles. The brightness with the 45 per cent transmittance diffusing shielding will become less uniform with the 24-inch spacing and noticeably non-uniform with the 36-inch spacing.

If a uniform brightness* appearance throughout is desired and a high brightness on the side walls parallel to the tubes is acceptable, space the first row one-half the distance (9 inches) from the wall and then continue the 18-inch spacing as shown in the example in Fig. 66. It is desirable that the tubes run the extent of the cavity. If this is not possible, a row of tubes may be added at the ends at right angles to the other tubes.

Using corrugated plastic with the tubes at right angles to the corrugations will help to smooth out the brightness. Another way would be to use panel units having concentric design patterns. These designs in themselves create variations that aid in counteracting the variations in brightness which are produced by the wide tube spacing. See Fig. 67.

With residential ceiling heights ranging between 7 feet 6 inches and 9 feet 6 inches, increasing or decreasing the ceiling height or cavity depth will have little effect upon the light level. In some situations, such as tubes between joists on 16-inch centers, it may be necessary to use two tubes in each cavity section between the joists to obtain the required lighting level.

Luminous ceilings utilize light more efficiently in larger rooms as compared with smaller rooms. In smaller spaces a high percentage of light is absorbed by surrounding surfaces, primarily walls. Therefore, to obtain equal light levels in small rooms or with sections of luminous ceilings, it is necessary to reduce the distance between tube centers and increase the number of tubes.

The light sources, 40-watt T-12 tubes (1½-inch diameter) used in the example in Fig. 66 are used with standard commercially available channel strip. This assembly places the tube center approximately 3½ inches from the ceiling (or back wall of the cavity in a luminous wall installation). Distance from tube center to shielding material is approximately 8½ inches. This distance represents an advisable minimum to keep in mind in designing ceiling or wall installations. See Fig. 68. When forced to deal with shallower cavities, every attempt should be made to keep the tubes as far as possible from the shielding material and as close together as possible, if a uniform appearance is desired. Light sources may be placed behind a shield in the plane of the diffusing panel and the lighting effect achieved by reflection. See Fig. 71. In some cases, it may be necessary to mount the

*Luminous ceiling brightness should not exceed 60 footlamberts for medium and large rooms (125 to 250 or more square feet) nor 200 footlamberts for a small room (60 to 125 square feet).

lampholders on metal raceway and locate the ballasts in some nearby available space, a closet, cabinet, attic or crawl space. When this is done, the ballasts are placed in a ventilated metal box that is easily accessible.

When fitting tube length to space dimension a check should be made of the channel strip length to be used. Some types of channel extend beyond the tube and lampholders, thereby increasing the over-all length. The type having lampholders flush with the end plate is preferable in making continuous rows of tubes. Lampholders can then be butted back-to-back for an even, smooth distribution of light. See Fig. 36.

The shielding material will greatly influence the light level and lighting results. The diffusing type in the example—45 per cent transmittance (45 per cent reflectance and 10 per cent absorption)—was selected to represent a middle value between clear and opaque materials. Denser materials will reflect more light back into the cavity, absorb more light in transit through the material, and transmit less light into the space. The advantage of using these denser materials lies in their capacity to aid in equalizing the brightness of the surface when a uniform low light level, low brightness appearance is desired. Maintenance of the same light levels as with the 45 per cent transmittance plastic will require an additional number of tubes spaced closer together.

Less dense materials reflect less light, absorb less and transmit more, but may have the disadvantage of less diffusing or concealing quality. The exact location of tubes may become apparent. With very high transmittance, the mechanics of the installation may be discernible, surface appearance becomes non-uniform, and the brightness may be so high within direct viewing angles that it will be uncomfortable for even short periods of time. For these reasons diffusing materials of a transmittance higher than 50 per cent are seldom if ever used. One of the few exceptions is the prismatic type plastic shown in Fig. 69. The refracting properties of this material provide higher transmittance but obscure tube location and prevent excessive surface brightness toward the eye.

When low light levels are required, one of several methods can be used:

(a) *Dimming Devices.* Retain uniform or semi-uniform surface brightness at lower levels depending on the spacing of the tubes. Closer spacing of tubes produces less variation in brightness at low levels.

(b) *Dual Switching.* When variation in surface brightness will not be objectionable, installation may be wired for separate switching of alternate rows of tubes.

Figure 69. Prismatic type plastic shields two rows of four 40-watt fluorescent tubes within 12-inch deep cavity, ceiling of which is flat black to reduce level in foyer and increase crystal effect of plastic. Low reflectance of Spanish tile floor aids in producing desired contrasts.

(c) *Coordination of Tube Location with Supports.* Most sheet materials and panel units come in 24-inch widths. This places supports 24 inches apart. Location of the tubes directly above or behind these supports will minimize the brightness of the lighted tubes from all but very oblique viewing angles. The use of low-transmittance plastic or glass will aid further in producing an approximately even brightness.

Variation in light distribution, brightness and color, and smaller areas of higher brightness accents are more often used in luminous walls than in ceilings. One easily accomplished and very interesting lighting effect can be achieved by installing a channel strip toward the front of the cavity on either the top (ceiling) or bottom (floor). See Fig. 70. In some cases it may be desirable to make provisions for both. Each installation should be wired for separate switch control. In this manner a nice gradation of light or color tinted light, that either descends from the top of the wall, or rises from the bottom, or is a combination of both, can be achieved. The possibilities for positioning and combining light sources on separate circuits within a cavity to produce variations of a decorative nature are almost limitless.

A reflected light technique may also be used in decorative "luminous wall" applications where the objective is to create visual interest and a low level of general lighting, and where cavity depth

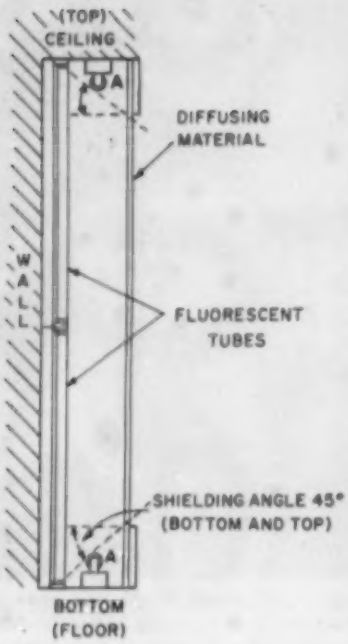


Figure 70 (left). Channel strips (A), located toward the front of the cavity, at either top or bottom or both, present additional possibilities for attaining variations in brightness patterns and color effects. When fluorescent tubes are used behind diffusing panels at locations A, a 45-degree shielding angle should be maintained at top and bottom.

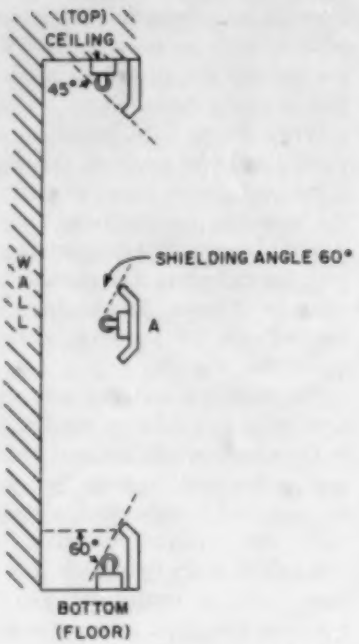


Figure 71 (right). Light sources (incandescent or fluorescent) installed behind shielding elements for reflected light technique. When the lighting effect is achieved by reflection a 60-degree shielding angle is recommended both at the bottom and for light sources located in the surface plane to prevent viewing at wide angles; a 45-degree shielding angle across the top will conceal light sources at this location. Shielding elements forming surface decorations (A) may be vertical, horizontal or criss-cross.

may be less than one foot. Light sources may be installed at the top and bottom of the cavity, horizontally and/or vertically, directly in back of structural or design members that form a part of the surface decoration, and then aimed toward the cavity. See Fig. 71. Both the brightness and the lighting level will be considerably lower than that resulting from direct lighting techniques. Similar applications in ceilings are, therefore, limited to passage areas, such as entrances and hallways, where a low level of general lighting would be acceptable at all times.

There are certain advantages to this method: it makes possible the use of decorative surface material, such as glass or plastic, with transparent or low density backgrounds or sections; and decorative grilles or frets may be used without a diffusing material as the lighted back wall of the cavity will present a similar appearance.

LIGHT SOURCES

A wide range of light source types can be used in these applications. Fluorescent linear sources are ideal for creating uniformly lighted large areas because of their low brightness, even light output, cool operating temperatures, narrow diameters and variety of length. They also offer variation in color quality of whites, warm and cool, in the improved-color rendition types, and in a range of colors—pink, blue, and yellow, for use in these applications when appropriate. The 30-watt (36-inch) rapid-start and the 40-watt (48-inch) preheat or rapid-start fluorescent tubes in the T-12 (1½-inch) diameter size are most commonly installed. If dimmers are to be used, dimming ballasts and rapid-start tubes are required.

By the proper use and spacing of incandescent sources luminous ceilings and walls may be uniformly lighted. However, the heat generated by the greater wattage required may be a deterrent to this practice, especially if a plastic type diffusing material is to be used. Incandescent sources usually serve best when used to provide accents of high brightness or of color. In luminous ceilings, when the shielding material is of a metal louvered form, projector and/or reflector lamps may be installed in addition to fluorescent to produce highlighting emphasis. Color tinted lamps can be added to produce soft color tinting of the louvers. This effect is most pleasing when planned as a definite pattern. Random use in ceilings may produce a circus or carnival feeling that is often not appropriate to the over-all interior design.

In wall installations, incandescent low-wattage (under 100-watt) bulbs can be used between the rows of fluorescent tubes in random or regular patterns or to accent portions of the surface design. These bulbs may be clear, inside frosted, or color tinted, all depending upon the desired lighting effect.

Light sources can be thought of as design mediums, similar to various color mediums, whereby numerous effects can be produced that have the additional interest values of brightness gradation and variations.

Figure 72. Porch ceiling of corrugated milky-white plastic is lighted by seven 100-watt projector bulbs (PAR-38)—two pink, two gold and three blue-white—in hooded bracket units mounted at random in the 24-inch overhang at the left. The 18-inch distance between the plastic and the bulbs permits direction and blending of tints to create variations in brightness and color for conversation or for dining.

SHIELDING MATERIALS

Diffusing shielding materials are plastic in most cases, although glass of comparable diffusion can be used in a similar manner if otherwise acceptable.

There is a great variety of diffusing materials for luminous ceilings. These may be thin plastic, corrugated for stiffness, or heavier plastic that has considerable rigidity and requires less corrugation. These same types of plastics are also used for formed modular units which are available in several sizes, as flat plates, concentric squares, or units having convex or concave designs. Formed designs in these modular units provide the necessary rigidity and also aid in creating pleasing surface patterns. Some of these formed units are made with acoustical as well as diffusing properties. There are also prismatic plastics, which produce more sparkle with less diffusion.

Thin flat sheet plastic of the type commonly found in lamp shades can be used when supported by a firm but delicately scaled grille, fret, or grid of wood or metal. These supporting materials can be colored to harmonize with the interior design theme. The flat sheet plastic is available in patterns that use touches of color.

Sheet type plastics of low transmittance, that vary in thickness up to one-eighth inch, are most frequently used for luminous walls. Any of the ceiling types can be used if suitable. Glass or other heavy-weight materials of similar transmittance can also be easily used since the weight-bearing support in wall installations is the floor.

When white or near-white diffusing materials are used in luminous walls, colored or tinted light sources can supply variations and gradations in color as well as light distribution and brightness. The material need not be plain. It can have variations in density, or a texture, or even a silhouette design if desired, but the most pleasing result is usually achieved when simple, conservative surface treatments are selected. Mural effects can be produced on a luminous wall by outlining a design on the front surface of the diffuser and then applying pastel tints of thin plastic or theatrical gelatin on the back to color the major or important portions.

When selecting diffusing materials it is always wise to observe the lighted appearance, as these materials will vary both in color quality of white and in textural character when illuminated. For a smooth or uniform lighted appearance, the diffusing material should also be checked for sufficient density to hide the location of the light sources.

Small-scale louver materials of plastic and metal, or louvers impregnated in sheet glass or plastic, are available with various shielding angles. These are used primarily in ceilings. In general, louvered shielding provides a lower brightness when viewing the expanse of the ceiling surface than diffuse materials. A small percentage of diffusion is produced by light striking the sides of the louvers, but planes directly below the louvers will not be shielded from the light sources. In those applications where images of the source may be reflected by shiny or glossy surfaces, therefore producing

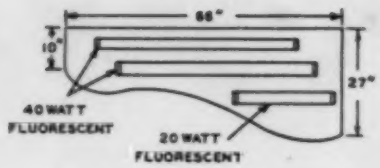


Figure 73. Free-form luminous panel over bathroom sink and vanity counter. The 12½-inch deep cavity above the rigid corrugated plastic contains two 40-watt and one 20-watt fluorescent tubes. Reflected in the mirror is the opposite wall, with a lighted cornice over the bath tub (in corner) and planter. (The shoji design is painted on the wall above the planter.)

annoying seeing conditions, diffusing materials will provide the better answer. In all other applications where matte or dull finishes are lighted or the reflected source images will serve a definite purpose, louvered shielding will be both efficient and effective. Both the diffusing and louvered shielding materials are available in pastel colors. Most of these shielding materials are light in weight and can be installed for easy access or removal for cleaning and relamping.

SUPPORT METHODS

In both luminous ceilings and walls, some means has to be used to support the shielding material. *Luminous ceiling* materials are generally supported upon flanged metal or plastic strips called "T-bars" (see Fig. 68). These may be suspended from the ceiling surface of the cavity or attached to the underside of joists or trusses. This is the method most commonly used. Other methods such as wood stripping, decorative molding (Fig. 65) or false beams can be substituted as long as there is a sufficient supporting flange.

Luminous walls require that the shielding material be supported by framing at the edges. This edge framing may be either metal or wood, so narrow as to be hardly noticeable or wide enough to act as an element of design emphasis, as with shoji panels. For maintenance, cleaning and relamping, these framed panels need to be either hinged to swing or tracked to slide for easy access to the cavity.

SURROUNDING SURFACE

Other large surfaces within the surroundings, solid walls or draped windows or walls, enter into the planning considerations for these structural lighting installations. Too great a difference in brightness between these surrounding surfaces and a luminous wall or ceiling will cause the latter to appear overly bright and visually uncomfortable. Attention to the reflectance values of the surroundings will help to prevent this condition. Reflectances of 45 to 60 per cent are suggested for walls, and the same percentages or higher for large fabric draped areas.

These reflectances become essentials when luminous ceilings are large in extent or low in height. In both cases the juncture of wall and ceiling planes comes within the field of view of room occupants when standing or seated. Reflectance of surrounding wall surfaces within the recommended limits as given above will always produce a more pleasing, less tiring, visually comfortable environment than those that are in sharp contrast.

Floor surfaces within the range of 25 to 35 per cent reflectance are preferable and have proven very harmonious with other suggested reflectances.

Photograph by Alexandre Georges; reprinted from House and Garden, *1959.*

Figure 74. Remodeled foyer in a bachelor's city apartment lighted by dimmer-controlled fluorescent tubes approximately three feet above a false ceiling of interlocking plastic circles. Interior Designer, Virginia Whitmore Kelly.

Photograph courtesy of Living for Young Homemakers.

Figure 75. Glass luminous wall with dimmer-controlled fluorescent tubes mounted horizontally on the wall behind the glass panels.

Figure 76. Circular grid plastic forms ceiling and two side walls to conceal twelve 96-inch fluorescent tubes mounted on the sloping ceiling 20 inches above the plastic at the low side and 29 inches at the high side. In addition to this general illumination, shielded fluorescent tubes beneath the wall cabinets provide local lighting on the counter surfaces. Architect, J. M. Morse. Photograph by Julius Shulman.

Significance of

Numerical Results of Photometry

By E. H. SALTER

A tendency has been noted for photometric test results, and data derived therefrom, to be reported and used as though figures might be reliable to three or four digits. This paper cautions against attaching significance to numerical results so reported, and supplies data to justify such caution.

THESE ARE the days of the computer. For a given set of input data, the computer may be programed to give results to almost any desired number of decimal places. Furthermore, for this given array of input data, the computer will give the same result each time the data are processed, even out to the last figure. If the computer did not behave in that fashion it would not be an acceptable computer.

Lighting calculations have in some instances been influenced by the use of computers, but over the years there have always been sharp pencils just as capable of providing answers to astounding numbers of apparently significant figures. It is not and has not been unusual to find data computed to four or five figures. There is serious doubt in this case, however, as to how many of these figures really are significant.

It is the purpose of this paper to examine certain of the data concerned with lighting calculations which may influence the significance of the results obtained. Data from two broad fields will be considered, one having to do with the design of lighting fixtures and the other with the application of such fixtures in lighting installations.

Data upon which lighting calculations are based come from either of two sources, *i.e.*, they are assumed, or they are based on measurements of one kind or another. In connection with fixture design, assumptions have to be made based on the properties of various materials to be used, experience gained in the use of these materials, assumed dimensions and spacings of parts, and on assumed lamp data. In application engineering, computations are more likely to be based upon the data obtained from a photometric test of a given fixture type. In either case, the significance of the result obtained will be limited by the extent to which such basic data are accurate and truly representative of the components or the fixtures in question.

Photometric test data, such as are used for lighting calculations, generally are the result of a single test of a single fixture specimen. Even where a device is very precisely made it is questionable to depend upon a single specimen as being representative of the performance characteristics of the manufacturer's total production of that design. The lamps that are the light sources for these fixtures probably are manufactured under more carefully controlled conditions than most of the fixtures in which they are used, yet the available performance characteristics for these lamps are based on large numbers of tests. For a fixture, however, one test usually must suffice.

Typical of the variations between individual specimens of lamps that may be used in establishing lamp ratinges are the data shown in Table I. The data for incandescent lamps were taken with the lamps burning at marked voltage after seasoning. The measurements of fluorescent lamps were made with the lamps operating in a 25C ambient, in series with a reference ballast from a voltage supply at rated voltage for that ballast, after seasoning at least 100 hours. It will be noted that individual lamps deviate from average by as much as 5 per cent and that the spread of data in a group runs to as much as 10 per cent of the average.

There is, of course, a good reason why only one fixture specimen normally is tested in order to determine the photometric performance of a fixture type; this is the cost of such testing. The industry cannot justify the cost of testing a number of randomized samples of each type of fixture. What limitations then are imposed on the value of such test data as are obtained?

Electrical Testing Laboratories has, over the years, recognized that the degree of sampling and the extent of tests have a bearing on the value of the results of any test. It is for this reason that

A paper presented at the National Technical Conference of the Illuminating Engineering Society, September 11-16, 1960, Pittsburgh, Pa. AUTHOR: Electrical Testing Laboratories, New York, N. Y.

TABLE I — Typical Light Output Measurements of Groups of Lamps.

Specimen No.	Light Output — Lumens Group 1	Group 2	Group 3	Group 4
Incandescent Lamps				
1	281	3581	261.3	614
2	274	3634	258.0	587
3	277	3629	262.0	613
4	273	3634	263.5	581
5	280	3664	264.5	577
6	265	3640	261.4	590
7	289	3561	262.0	580
8	282	3552	266.9	589
9	282		250.4	586
10	269		257.2	580
11	268		276.5	
12	270		260.8	
13	268		267.1	
14	276		257.7	
15	267		261.3	
16	266		264.8	
17	267			
18	279			
19	279			
20	281			
Average	275	3612	262.2	589
Maximum Deviation from Average — Per Cent	3.6	1.7	5.5	4.2
Spread — Per Cent of Average	6.2	3.1	10.0	6.3
Fluorescent Lamps				
1	2520	2253	2640	4620
2	2535	2260	2690	4613
3	2525	2272	2625	4636
4	2465	2285	2640	4633
5	2475	2288	2645	4624
6	2490	2270	2675	4633
7	2470	2262	2660	4616
8	2510	2265	2625	4605
9	2480	2230	2645	4623
10	2540		2615	4629
11	2450		2620	4620
12	2510		2625	4571
Average	2498	2265	2640	4619
Maximum Deviation from Average — Per Cent	1.9	1.9	1.9	1.0
Spread — Per Cent of Average	3.6	2.6	2.8	1.3

our test reports for 30 years or more have carried a footnote reading in part as follows:

> "The significance (of this report) is subject to the adequacy and representative character of the samples and to the comprehensiveness of the tests, examinations or surveys made."

These words at least sound a warning that sampling and extent of testing may be of major import.

Whenever measurements are made, some limitations as to the accuracy of measurement is implied. Accuracy is not independent of the many factors that enter into a measurement. Normally, accuracy is relative to the instruments that may be available, their calibration status, and to the procedures established for making the required measurements, as well as the representative character of the specimen.

In the field of photometry, measurements made under even the most precise conditions generally have a limit of accuracy of the order of one-quarter to one-half of one per cent. Measurements to within these limits can be obtained only under the most carefully controlled conditions. Even then, such precision can be obtained only in measurements of the more stable types of light sources, for instance, certain types of incandescent lamps. As soon as the measurements problem is complicated by the addition of fixture parts, or by other limitations when an entire lighting unit is under study, the limit of accuracy of measurements of a given assembly of parts is widened to something of the order of one to two per cent.

Very few lighting fixtures are so precisely made that their parts go back into exactly the same position when they are taken apart and put together again. To disassemble completely and then reassemble a lighting unit can have a marked influence on its performance. This applies even to the manner in which a lamp goes into a lampholder. Screw base lamps will not always seat in the same position in the lampholder with the result that the light center may shift each time the lamp is removed and replaced. Experience in the testing of narrow beam downlights has indicated that test results can be duplicated with assurance only when the lamp remains in the lampholder from one test to another. Fig. 1 illustrates the sort of thing that happens when two tests are run using different lamps of the same type, because of physical differences in the lamps, even though these differences were all within normally accepted tolerances.

This measurement problem may be further complicated by variability between parts and possible variability in assembly, such as may be encountered in a second specimen of a lighting unit. With this condition, the over-all reproducibility between tests must be further widened to possibly five or ten per cent, even though the repeatability on any individual specimen, or combination of parts in one assembly, might still be within the one or two per cent limits. Typical of what happens are the test results for simple industrial types of incandes-

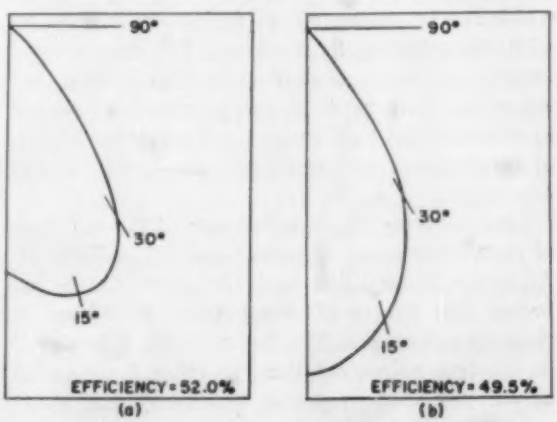


Figure 1. Change in candlepower distribution caused by changing test lamp in a downlight.

TABLE II — Typical Reflectance and Efficiency Measurements of Groups of Luminaires.

Specimen No.	Reflector Reflectance				Luminaire Efficiency-Per Cent			
	Group A	Group B	Group C	Group D	Group A	Group B	Group C	Group D
				Incandescent Lamp Luminaires				
1	0.85	0.87	0.85	0.83	83.0	83.0	80.5	75.5
2	0.84	0.87	0.82	0.87	84.0	86.0	78.5	73.5
3	0.87	0.86	0.83	0.86	81.5	85.0	80.5	73.5
4	0.85	0.87	0.82	0.88	85.0	86.0	75.0	78.5
5	0.85	0.88	0.87	0.86	83.9	84.5	83.0	81.0
6	0.86	0.87	0.88	0.86	82.0	83.0	84.9	80.0
7	0.86	0.89	0.85	0.89	83.5	88.0	81.5	75.0
8	0.88		0.87		84.0		89.0	
9			0.89				85.0	
10			0.90				84.0	
Average	0.858	0.873	0.856	0.867	83.3	85.1	81.6	76.7
Maximum Deviation from Average — Per Cent	2.6	1.9	4.9	4.3	2.2	3.4	6.9	5.6
Spread — Per Cent of Average	4.7	3.4	9.3	6.9	3.0	5.9	12.2	9.8
				Fluorescent Lamp Luminaires				
1	0.83	0.85	0.89	0.86	79.6	83.0	84.0	79.0
2	0.80	0.85	0.89	0.85	81.0	79.0	81.5	79.0
3	0.83	0.85	0.87	0.85	79.0	79.0	83.5	76.5
4	0.83	0.84	0.88	0.84	81.5	83.5	82.0	81.0
5	0.85	0.88	0.86	0.86	80.5	86.5	79.5	79.9
6	0.87	0.86	0.85	0.86	81.5	82.0	79.0	83.9
7	0.87	0.87			82.5	80.0		
8	0.87	0.87			79.5	83.0		
9	0.86	0.87			84.0	84.0		
Average	0.850	0.868	0.873	0.853	81.0	82.2	81.3	79.6
Maximum Deviation from Average — Per Cent	5.9	3.2	2.6	1.9	3.7	5.2	3.3	4.6
Spread — Per Cent of Average	6.2	4.6	4.6	2.4	6.2	9.1	6.2	8.8

cent and fluorescent luminaires shown in Table II. In this case, specimens of these fixtures are selected periodically and subjected to test. To all intents and purposes the individual fixtures tested in each case are identical, though they have been manufactured at different times. Note the variations from fixture to fixture, where deviations from average go as high as 6.9 per cent, and the spread between individual fixtures in a group is as much as 12.2 per cent of the average.

The first reaction to these data might be that such differences as shown are largely due to differences between the lamps used in the various tests. Such is not the case, however, in these units which are not hypercritical to lamp placement as with concentrating fixture types. The standardized testing procedure, established by IES, is such that the actual lamp used for test purposes is assumed to deliver rated light output and all computations of candlepower and brightness are based on that assumption.

Measurements of the reflectance of the reflectors of these fixtures are likewise tabulated in Table II. All other things being controlled, it would be expected that fixture efficiency would be related to reflector reflectance. The fact that this is shown to be not true points out that the other factors such as reflector shape, reflector dimensions and placement of the reflector are not fully controlled.

Spread between different specimens of the same fixture type can be due to lack of precise control of the placement of the lamp or lamps, the shape and placement of the reflecting parts, the finish (reflectance) of reflecting parts, the density (transmittance) of transmitting parts. Reflecting parts, even though die-formed, may not be exactly the same shape; these parts when finished, be they oxide-finished, plated, painted or porcelain-enameled, are likely to vary in reflectance from one part of the reflector to another and especially between reflectors. Transmitting parts require close control in order to maintain characteristics, especially when translucent rather than transparent.

An example of what the transmittance of side panels can do occurred a few years back. One of the manufacturers having extensive laboratory facilities submitted a fluorescent fixture for test. When results were reported it was found that the fixture showed only 84.0 per cent efficiency where the manufacturer's tests showed 88.0; another variation of this same fixture showed only 72.5 per cent against an original value of 77.0. The unit submitted was supposedly the identical unit that had been tested by the manufacturer. An intensive search followed to determine the cause of the wide difference between laboratories. After several months of work, it developed that the transmitting parts submitted by the manufacturer were not the parts used in his tests. When he finally furnished the parts that he had used, the results ob-

tained in the two laboratories came into substantial agreement.

All of this, of course, means that the over-all value of test data is influenced not only by the accuracy with which a given measurement may be made but by the representative character of the specimen submitted for test.

A similar condition exists in connection with design computations. In the design of a fixture, the designer assumes the use of certain materials, the type of lamp that will be used, the location of the lamp or lamps within the fixture, the finish and hence the reflectance of reflecting parts, and the transmittance of transmitting parts. If design procedures are founded on known and proved methods, the performance of the fixture should be predictable within acceptable limits of accuracy. Bill F. Jones in his paper at last year's conference on "Use of Computers in Design and Analysis of Lighting Fixtures" presented such an approach to fixture design. (See ILLUMINATING ENGINEERING, July, 1960, p. 386.)

There could, however, be a wide gap between the design of a fixture and all of the factors assumed to be applicable thereto and the quantity production of that fixture. Unless the fixture as produced corresponds in every detail with the fixture as designed, its performance will be affected. The materials used, the shapes of parts, reflectances and transmittances, each and all will play their parts in determining the extent to which the performance of the fixture as finally produced duplicates its designed performance based on the assumptions used for these factors. Uncontrolled factors here may have equally large effects as they have in test differences beween different specimens.

Lighting calculations, however, do not end with the performance characteristics of a fixture, whether these performance characteristics are determined from test or computed from design. From these performance characteristics coefficients of utilization are computed which in turn are used to compute the expected lighting levels for installations using this fixture. Anything therefore that casts doubt on the limits of accuracy of the performance characteristics will cast an equal doubt on those of the coefficients of utilization computed from these data. Coefficients of utilization will therefore be representative of the given fixture only to the extent to which its performance characteristics, as determined by test or computation from design, correspond to those of the fixture as produced by the manufacturer.

When in doubt as to the significance of data, the usual practice is to round off results to what is felt to be the last dependable decimal place. This is a right and proper way of handling data but here it must be realized that in so doing the apparent difference between two fixtures may be unjustifiably emphasized. For instance, in comparing the results for two fixtures it is found that single test results give coefficients of utilization of 0.494 and 0.506, a difference of 0.012. If these data are rounded off to two decimal places they become 0.49 and 0.51, which would indicate a wider difference (0.020) between the two units. However, in the light of known limitations of test results these two units may be alike since their deviations (0.006) from 0.50 are within the limits of accuracy for such measurements of a given fixture. All of this is to say that differences of one or two points in the second figure of coefficients of utilization may or may not be significant.

There is nothing new in the facts and thoughts that have been presented herein. To those who have been engaged in the measurements of lamps and fixtures, the facts have been known for many years. There is, however, a wide gap in understanding or appreciation of this between those who obtain such test data and those who make use of it in the field. In many instances, those who use these data have not been made aware of its limitations. In other instances, it has been advantageous not to advise a potential user of the meaning or possible lack of meaning of small differences in test data between fixtures offered for a given installation.

The choice of a fixture for a given installation frequently has been made on the basis of giving undue weight to such small differences in efficiency or coefficient of utilization. When it is realized that such differences may not have any real significance, it is seen that such a choice may not always be a wise one. Surely other considerations, such as overall fixture quality, ruggedness, ease of maintenance, should be weighed against the significance of apparent advantages based on efficiency or coefficients of utilization. Lighting application engineers should be made aware of these facts.

To the casual observer it might appear that the above arguments suggest that the photometric testing of lighting fixtures is a waste of time and money. For such arguments as these to be advanced by one who makes his living performing such tests may appear to be suicidal. A snap decision might be that if test data are in any way doubtful, then let us save time and money by eliminating testing and the many other headaches associated with this problem.

Such, indeed, would be a very shortsighted procedure. In spite of doubts as to the accuracy of results carried to three or four digit figures or the significance of minor differences falling within the limits of measurement technique, there is no other

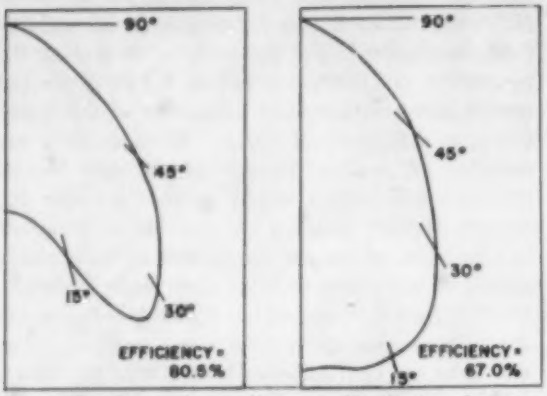


Figure 2. Change in candlepower distribution due to a small change in lamp position in a deep bowl reflector.

way to find out what to expect in the way of performance of a lamp or a fixture as produced than to test it. Fixtures that look alike may actually differ in performance by 20 per cent or more. Fig. 2 shows an example of such differences. Even an expert may not be able to properly evaluate this difference by inspection. Distribution and curve shapes are indicative of the value of a fixture for certain applications, regardless of actual efficiency. In many instances, curve shapes, per cent zonal fluxes, brightnesses and other data are independent of the over-all efficiency. Hence, test data will in most cases convey a wealth of information.

Such test data have marked value when used with a knowledge of the limitations imposed by the adequacy and representative character of the specimen or specimens tested. It is then the knowledge of these limitations that becomes important—especially to those who recognize and make intelligent use of it.

Nighttime Golfing in San Jose

Boon to weekend golfers plagued with crowded courses is the nine-hole, 1650-yard Ironwood Course in San Jose, the first golf course in Northern California to be lighted for nighttime play. Fairways have an illumination level of about five footcandles, brighter than most downtown streets; lighting level on the greens is ten footcandles. Illumination is from type L-69A floodlights with 1500-watt lamps mounted on 40-foot standards. Four to six floodlights per standard are used on the greens; two to five lamps per standard on the fairways and tees. Total load for the system is 165 kw. Because of the long feeders, a 277/480-volt distribution system was installed to reduce voltage drop.

Lighting was engineered and installed by Roy M. Butcher Electric Co., San Jose, Calif. Photo and data courtesy of General Electric Co., Schenectady, N. Y.

A "Recommended Practice for Airport Service Area Lighting," prepared by an IES Task Committee, has been approved by Council and published in the July, 1960 IE. This paper is intended as an application of this Recommended Practice to a typical large airport.

Lighting of Airport Service Areas

By E. B. KARNS

CONSIDERABLE EFFORT has been expended and relatively detailed recommendations have been prepared for solving problems relating to airport approach, runway and taxiway lighting. Yet, little has been available on the subject of airport service area lighting. By service area, we mean the area where the aircraft is temporarily packed at a loading ramp for discharging or taking on people, baggage and cargo. In this area, aircraft are also inspected and serviced in preparation for continuing in flight.

Service Area Seeing Tasks

Primary functions of the service area lighting installation are (a) to enable the pilot to guide (taxi) his aircraft into final positioning for loading and service; and (b) to provide lighting suitable for personnel to load and unload passengers and cargo, load fuel, and perform other apron service functions.

Minimum corridor depth for which reasonable uniform illumination must be provided is about 200 feet; maximum depth range is from 200 to 300 feet out from the entrance and exit gates of the terminal facility.

Passenger Loading and Unloading

Normally, for passenger loading and unloading, it is not as important to have a great deal of light as it is for some of the other operations. However, it is psychologically advantageous to provide enough light so the passengers have a sense of security. It also adds prestige to the airlines and to the terminal facilities.

Approaching Pilot

The approaching pilot must have sufficient illumination to enable him to identify his destination and steer clear of obstructions. This can be accomplished with relatively low levels of light, providing glare and high-brightness contrast are minimized. General lighting permits the pilot to perform this function.

Adequate illumination for this seeing task is obtained by employing horizontal lighting levels of one foot-candle average maintained in service on the pavement surface. Higher levels of illumination serve to provide a higher quality of lighting, and general increased visibility.

In order to provide optimum visibility for the approaching pilot, it is essential that the service area pavement be lighted uniformly within a 4 to 1 uniformity range (average to minimum). This may be done if suitable attention is paid to the types of light sources, their optical systems, and location of equipment with relation to the service area. Above all, attention must be paid to the reduction of disability and discomfort glare.

Servicing of Aircraft

Practically every other visual task performed in the service area emloys light reflected from the working surface. This requires direct illumination of relatively high levels. Surfaces range from horizontal to vertical. An average illumination level of at least two footcandles maintained in service is normally considered necessary for illumination of objects where fine visual acuity is not essential.

Combination of General and Direct Lighting

It is evident that the minimum installation must be capable of providing an average level of illumination of one horizontal footcandle (maintained in service) over the surface of the entire area, for the benefit of the approaching pilot; while levels of 2.0 average vertical footcandles are necessary at the near side of the aircraft for additional visual tasks performed in connection with servicing of the aircraft.

Acceptable Methods of Lighting Design

The most important consideration in designing the lighting installation, aside from the essential

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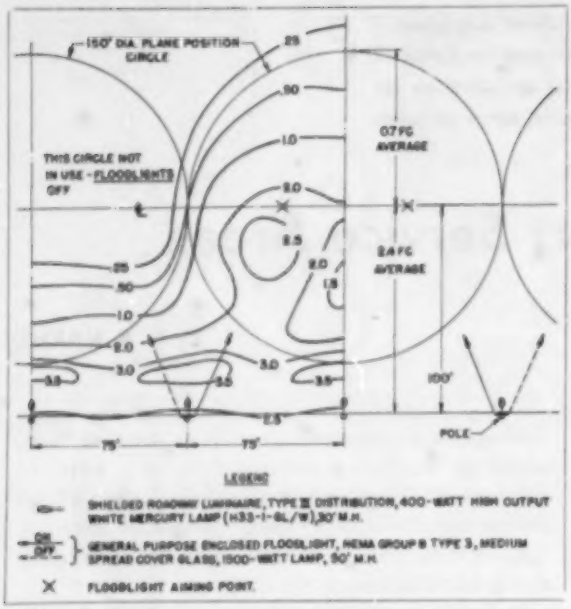
150' DIA. PLANE POSITION CIRCLE
THIS CIRCLE NOT IN USE - FLOODLIGHTS OFF
0.7 FC AVERAGE
2.0 FC AVERAGE
100'
POLE
75'
75'
LEGEND
SHIELDED ROADWAY LUMINAIRE, TYPE III DISTRIBUTION, 400-WATT HIGH OUTPUT WHITE MERCURY LAMP (H33-1-BL/W), 30' M.H.
ON OFF
GENERAL PURPOSE ENCLOSED FLOODLIGHT, NEMA GROUP B TYPE 3, MEDIUM SPREAD COVER GLASS, 1500-WATT LAMP, 50' M.H.
FLOODLIGHT AIMING POINT.

Figure 1. Layout and isofootcandle lines for combination 400-watt mercury luminaires and 1500-watt incandescent floodlights.

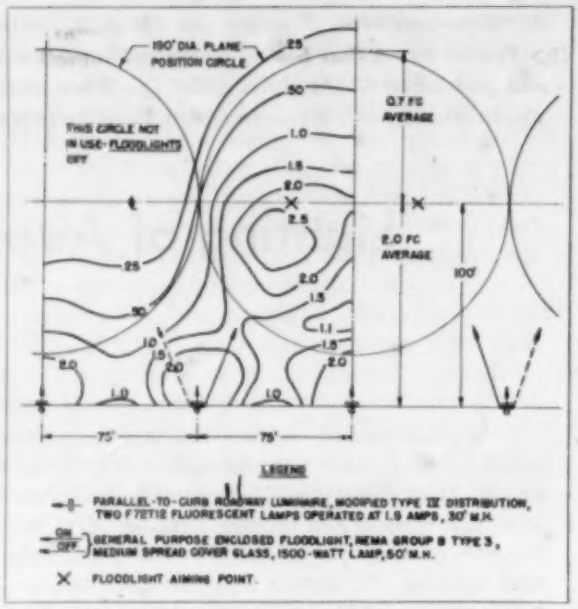
150' DIA. PLANE POSITION CIRCLE
THIS CIRCLE NOT IN USE - FLOODLIGHTS OFF
0.7 FC AVERAGE
2.0 FC AVERAGE
100'
75'
75'
LEGEND
PARALLEL-TO-CURB ROADWAY LUMINAIRE, MODIFIED TYPE III DISTRIBUTION, TWO F72T12 FLUORESCENT LAMPS OPERATED AT 1.5 AMPS, 30' M.H.
ON OFF
GENERAL PURPOSE ENCLOSED FLOODLIGHT, NEMA GROUP B TYPE 3, MEDIUM SPREAD COVER GLASS, 1500-WATT LAMP, 50' M.H.
FLOODLIGHT AIMING POINT.

Figure 2. Layout and isofootcandle lines for combination fluorescent luminaires and 1500-watt incandescent floodlights.

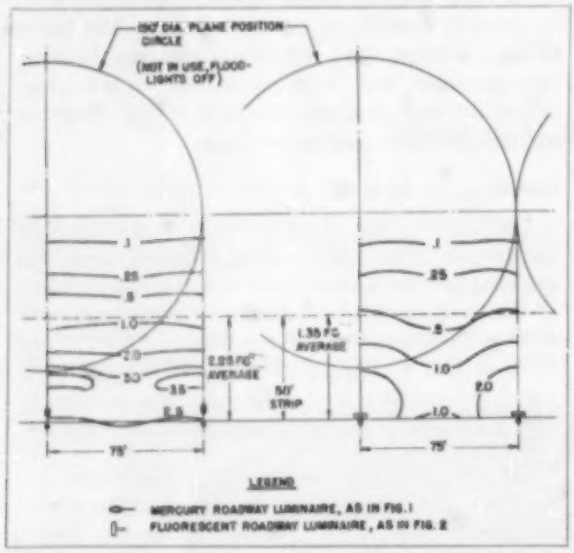

Figure 3. Layout and isofootcandle lines for 400-watt mercury luminaires alone and for the fluorescent units alone.

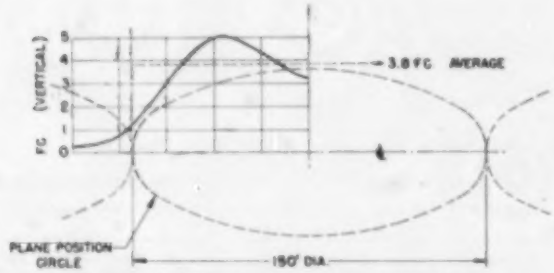

Figure 4. Illumination on vertical plane.

nature of providing uniformity of illumination of the service area pavement, is that of keeping glare to a minimum. Glare from bright sources in line of sight is particularly troublesome to the control tower operators and pilots of the aircraft taxiing in the general vicinity, as well as service personnel, passengers, and, in short, everyone making use of service area and service area facilities. Factors affecting glare are (a) location of luminaire or luminaires; (b) direction of light beams, and (c) type of light source and luminaire.

Luminaires employing high-brightness filament or mercury sources are acceptable for service area lighting when mounted at suitable mounting heights on buildings or poles. Mounting heights of these units should be as great as possible, the minimum being not less than 50 feet for floodlights and not less than 30 feet for street lighting types of luminaires. Lower brightness luminaires, such as fluorescent, may be mounted at lower heights if proper shielding or diffusion of bare lamp light is employed.

Application Layout

Fig. 1 shows a method of lighting the service area at an airport. For ease in defining the aircraft's position, plane position circles are shown. The lighting is designed in units for each circle, so that the layout could apply to any number of service spaces.

This layout uses 400-watt silver white lamps in conventional roadway luminaires with 360-degree

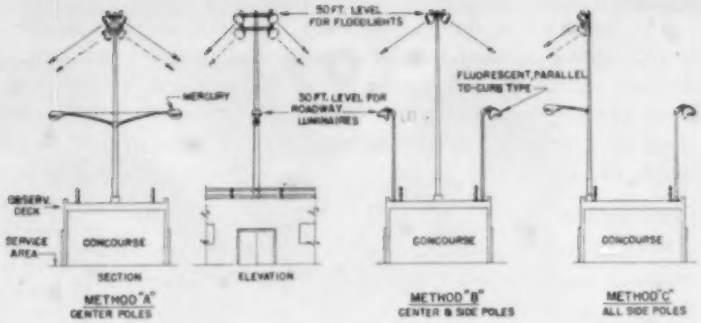

Figure 5. Pole mounting arrangements for both general lighting and floodlighting.

shields or visors. These provide a complete cutoff of light above horizontal, thus removing any brightness from the control tower field of vision, and also shielding them from the view of approaching aircraft. These units provide the general illumination, and operate continuously at night.

When the plane is in position two floodlights are turned on, providing direct illumination for servicing the aircraft. The combination provides horizontal footcandles as indicated by the isolux lines.

Fig. 2 shows the same layout, but fluorescent units are used instead of the mercury for the general lighting. Fig. 3 shows the in-service footcandles for the general lighting only.

Fig. 4 is the illumination maintained in service on a vertical plane along the longitudinal center line of position circle and parallel to it.

Fig. 5 shows a typical pole arrangement for floodlights and street lights. The spacing between the floodlighting poles is 150 feet, while the spacing of the mercury units or fluorescent units is 75 feet.

When aircraft are parked in double rows, additional floodlights are added to take care of the other row. Where better architectural appearance is desired, special structures can be designed for the job, such as shown in Fig. 6.

Good service area lighting for single-row aircraft parking without the use of floodlights at the higher mounting heights is possible. Fig. 7, a photograph of the Moisant Airport at New Orleans, is an example of this. The lighting was designed by Mr. L. N. Goodman, Consulting Engineer. It consists of 1000-watt mercury lamps in roadway lighting luminaires with shields. The mounting height is 35 feet and the spacing is 60 feet. It provides an average of two footcandles over a 100-foot band, with approximately 0.3 footcandles horizontal and 0.5 footcandles vertical at 100 feet out from the building. Similar results can be obtained with fluorescent floodlights, but usually more units at closer spacing will be required.

Economics

The two-part system general lighting, with low-mounted units and floodlights for direct lighting on the aircraft, allows some savings in power. That is, the floodlights can be turned off when an aircraft is not being serviced.

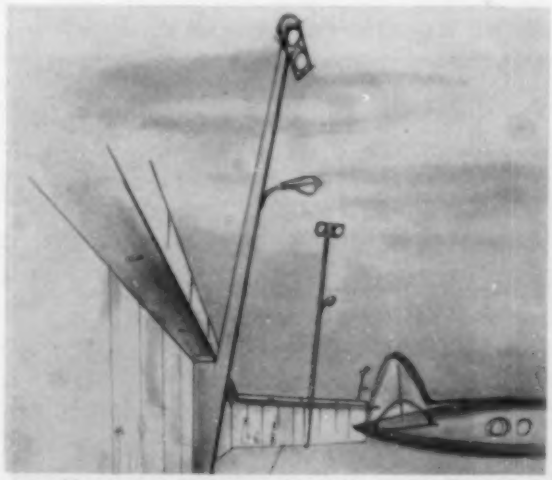

Figure 6. Artist's sketch of special design luminaire and floodlight support.

Figure 7. Moisant Airport, New Orleans—1000-watt mercury luminaires with shields at a mounting height of 35 feet on 60-foot spacing; average footcandles, 2.0.

The mercury or fluorescent lamp has been selected, since either one is more efficient than incandescent and has much longer life. When using these gaseous discharge lamps it is well to stagger them on a three-phase system to minimize stroboscopic effect.

Conclusions

Service area lighting, generally speaking, has not received the attention it warrants. Too often the designer, as well as the operator, has not fully realized the importance of this area. Aside from the importance of the service performed in this area, this is the first of the terminal facilities the in-coming passenger sees, and it is here that he often form his impressions.

The I.E.S. Recommended Practice, as now published, provides minimum values maintained in service, and should be considered as such. The cost of service area lighting in excess of these values is a small percentage of the total cost of a modern airport. Higher levels of illumination are justifiable. They improve the safety and efficiency of the operation and add prestige to the airline using the facilities.

Furthermore, it is important to the airport management to install higher levels of illumination to impress the public with its progressiveness and consideration for the safety and comfort of those who use the airport facilities.

Acknowledgments

Acknowledgment of contribution of engineering assistance and drawing is hereby given to H. E. Lippman of Westinghouse. I also wish to acknowledge information contributed by the entire IES Task Committee assigned to the preparation of the "Recommended Practice For Airport Service Area Lighting."

Miami International Airport

Nighttime operations at Miami International Airport are facilitated by high levels of illumination for both passengers and aircraft servicing crews. Tilt-mounted fixtures each using two extra-high-output TD17 fluorescent lamps are installed on each side of six "fingers" extending from the central terminal building (one of which is shown below) to provide comfortable illumination in the service areas. These units also supply sufficient illumination for passenger traffic entering and leaving through the 84 gate positions in the terminal.

Loading aprons and a large automobile parking area (not shown) across from the central terminal building are lighted by 400-watt improved-color mercury luminaires mounted two to a pole.

Airport lighting was designed by Maurice Connell & Associates; parking area lighting by Rader and Associates. Photo and data courtesy of General Electric Co., Nela Park, Cleveland, Ohio.

A.I.A. File No. 31-f

INSTALLATION AT FAIRMOUNT HOSPITAL, JERSEY CITY, N. J.

Lighting a Hospital Laboratory

LIGHTING OBJECTIVE: To provide illumination to quickly and accurately perform and record hospital laboratory analyses and tests.

GENERAL INFORMATION: This laboratory measures approximately 14 feet by 30 feet with a ceiling height of 9 feet 8 inches. Colors and reflectances of the major room surfaces are:

ceiling	light green	63% RF	benches		
walls	light green	63% RF	top	gray albarine	20% RF
floor	gray	30% RF	side	light gray	50% RF

INSTALLATION: General lighting is provided by 23 DeVoe Lighting Corp. catalog No. 25240 RS suspension mounted luminaires, each equipped with a dished plastic diffuser and two 40-watt T-12 cool white rapid-start fluorescent lamps. These units are mounted approximately 8 feet above the floor. Twenty of the units are arranged in four rows of five on 3-foot centers. The remaining three are located at bench positions along the two-end walls.

Localized bench lighting is provided by Ender Monarch Corp. catalog No. CEL 140 RS luminaires, each equipped with plastic diffusers and one 40-watt T-12 cool white fluorescent lamp. Units are mounted 26 inches above center benches, on underside of shelves, and 15 inches above perimeter benches, on underside of enclosed hanging cabinets.

After two years of operation, the average level of illumination at bench height was 105 footcandles. Brightnesses were:

ceiling luminaire at 45° crosswise	630 fL	walls	61 fL
at 45° lengthwise	600 fL	floor	20 fL
bench luminaires at 90° crosswise	950 fL	benches, top	20 fL
ceiling	20 fL	sides	10 fL

Lighting designed by William Neumann and Sons, Architect, 591 Summit Ave., Jersey City, N. J.

Lighting data submitted by H. O. Spliethoff, Public Service Electric and Gas Co., 84 Sip Ave., Jersey City, N. J. as an illustration of good lighting practice and to aid in the design of similar installations.

Published by the Committee on Publications of the Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

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UNITIZED URBANOVAL
No. 2531-B175

REVERE
URBANOVAL
No. 2501-B250

New Revere 2500 Series Urbanoval luminaires use 100, 175 or 250-watt mercury lamps. Unitized Urbanoval features built-in constant-wattage or reactor ballasts. Conventional Urbanoval is designed for external ballasting. Both types are available with or without mounting adapter for E.E.I.-NEMA standard plug-in locking-type photo-electric control. Choice of Revere-Corning Pyrex® molded prismatic refractors provides I.E.S. Type II or Type II—4-way distribution (or Type III or 4-way with phosphor-coated lamps). Available with 1¼" or 2" slipfitter.

NEW FAMILY OF REVERE LUMINAIRES

New *unitized* oval mercury luminaires with built-in ballast components are the latest addition to the Revere family of street lighting equipment. New 2600 Series Endoval luminaires provide high-level, glare-free illumination for arterial streets and highways. New 2500 Series Urbanoval luminaires are designed to provide economical lighting for residential areas or secondary streets where uniform, low-level lighting is desired. Both series offer the advantages of modern styling, substantially reduced installation costs, and efficient, economical performance.

Revere's new unitized luminaires together with newly designed conventional luminaires let you solve every street and highway application problem the one *best* way. You can select high quality, design-matched Revere luminaires, poles and equipment specially engineered for every street lighting need. *Send for complete catalog information and technical data.*

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In Canada: Curtis Lighting, Ltd., Leaside, Toronto, Ontario

New Revere 2600 Series Endoval luminaires use 250 or 400-watt mercury lamps. Unitized Endoval features built-in constant-wattage or reactor ballasts. Conventional Endoval employs same housing, reflector and Revere-Corning Pyrex® molded prismatic refractor, but without built-in ballast components. Both types are available with or without mounting adapter for E.E.I.-NEMA standard plug-in locking-type photo-electric control. Adjustable socket positions produce A.S.A.-I.E.S. Types II, III, or IV with proper choice of lamp.

REVERE
UNITIZED ENDOVAL
No. 2633-B400

LIGHTING NEWS

January 1—Deadline for Gold Medal Nominations

Nominations for the IES Gold Medal, illumination's highest honor, must be received at Society Headquarters by January 1, to be considered for the 1961 award. Any member of the Society may make a nomination by submitting, to the General Secretary, the name of a candidate worthy of this high honor. Field of accomplishment may be engineering, lighting research, optics, applied illumination, ophthalmology, education, design or administration and management. Candidates need not be citizens of the United States or Canada, or members of the Society, to be eligible for the award.

The Gold Medal is awarded "for meritorious achievement which has conspicuously furthered the profession, art or knowledge of illuminating engineering." Presentation of the 1961 Medal, together with an appropriately embossed certificate, will be made during ceremonies at the 1961 National Technical Conference in St. Louis.

When deciding upon the Medallist, the Medal Award Committee gives consideration to candidates who have been nominated in previous years.

Lighting Maintenance Contractors Open National Headquarters

The National Association of Lighting Maintenance Contractors has announced the establishment of national offices at 2120 Keith Building, Cleveland, Ohio, and the appointment of an executive secretary, Will Carlton. The announcement was made by Melvin H. Gailbraith, president of the organization of firms who clean, relamp and repair lighting fixtures on a contract basis.

Membership in NALMCO is now close to 100 firms, with representatives from major cities in the United States and Canada, and one member from England. Officers of the organization, in addition to Mr. Gailbraith, include: M. H. Gray, secretary; Kenneth Purington, treasurer; Van Christenson, John Razzano, Walter Fink, Richard Peters, Robert Merriam, vice-presidents; Eugene St. Jean, Elmo Irwin, Barney Roth, E. I. Creed and Robert Watson, directors.

At the sixth annual association convention, held in Milwaukee this fall, NALMCO adopted a code of ethics governing member firms.

Publicity Campaign Organized For National Electrical Week

Plans for the observance of National Electrical Week, February 5-11, 1961, were formulated by the National Electrical Week Committee at a recent meeting in New York City. The planning guide, outlining details for participation in NEW is scheduled for distribution in mid-October, according to Harold A. Webster, Chairman of the NEW Committee. Observance materials, including speeches, special pamphlets and display materials, Edison Replica Lamps, television film clips and reproduction proofs of the National Electrical Week emblem, will be available through NEW headquarters, Suite 306, 407 N. 8th St., St. Louis, Mo.

National Electrical Week is sponsored by nine electrical industry groups—American Home Lighting Institute, Canadian Electrical Council, Edison Electric Institute, International Association of Electrical Leagues, International Brotherhood of Electrical Workers, National Appliance Service Association, National Association of Electrical Distributors, National Electrical Contractors Association and National Electrical Manufacturers Association. In addition, other industry groups, Reddy Kilowatt, Inc., Electric Companies Advertising Program and Public Utilities Advertising Association, are preparing copy and advertising materials in support of NEW.

Several special programs designed to provide a background for National Electrical Week have been coordinated with industry conventions. The Seventh Annual National Electric Farm Power Conference in Louisville, September 21-23, featured an address by a representative of the NEW Committee and a supporting

CERTIFICATE of appreciation to Dean Arthur B. Gallion (left) for his efforts in stimulating interest in lighting among students at the University of Southern California School of Architecture was presented by Roy E. Dahlin on behalf of the Southern California Section and the national IES Allied Arts Committee. Occasion for the award was a farewell party for Dean Gallion who recently resigned from USC to take a position as director of planning for Harland Bartholomew and Associates in Honolulu, Hawaii.

display. A similar display and address was on the program of the National Electrical Contractors Association's October convention in Las Vegas.

Lighting Conference for Architects, Consulting Engineers

Problems and ramifications of lighting design, discussed from the standpoint of the architect and consulting engineer, will be the subject of a three-day conference at the General Electric Lighting Institute, Nela Park, October 26-28.

Emphasis at the conference will be on the balance between quantity of illumination and brightness quality and the esthetic implications of lighting design. Closely-related subjects, of great concern to architects and consulting engineers, such as the integration of lighting and air conditioning and color concepts, will also be discussed.

The third conference session will be an outdoor lighting forum devoted to "the second aspect of architecture and city planning" and featuring such topics as building floodlighting, decorative lighting, area lighting, sign lighting and landscape and garden lighting.

In addition to the architecturally-oriented subject matter, the program will cover principles of good lighting for offices, industrial areas and schools, and the latest developments in light sources.

Burton H. Holmes, AIA, technical editor of *Progressive Architecture*, will be the after-dinner speaker on Thursday, October 27.

High-Voltage Test Lab Opened at Cornell

The first electrical testing station for extra-high-voltage underground cable was officially opened at Cornell University, Ithaca, N. Y., in mid-September. The station, a cooperative venture by manufacturers, utility company associations and the University, will be used to conduct field tests under severe loading conditions on underground cable systems designed for 354,000-volt operation. Test voltage will gradually be increased to 500,000 volts in subsequent phases of the project.

The official opening of the testing station marks the completion of the first phase of a project conceived in 1953 when the upsurge of overhead transmission voltages and station machine capacity made necessary the development of underground cable systems capable of carrying loads of 500,000,000-volt-amperes. The second phase of the project, scheduled over a period of three years, involves energizing the systems. During the first two years, voltage will be raised in gradual steps from 345,000 to 415,000 volts with loading temperatures comparable to commercial operating conditions. Following this, to further determine the characteristics of the system, tests will be made with elevated temperatures and voltages up to 500,000 volts.

Included in the field station are a number of proven cable systems with low-pressure, lead-sheath, self-contained, oil-filled cable; high-pressure, oil pipe type cable; high-pressure, aluminum-sheath, self-contained, oil-filled cable and high-pressure, oil pipe type cable.

Lighting Fixture Display Planned For Chicago Modern Living Show

Some 200 residential lighting fixtures, for all areas of the home, will be exhibited at the Modern Living Home and Flower Show, scheduled for November 18 to December 4 at McCormick Place in Chicago. Participating in the display, which is being sponsored by the Electric Association of Chicago, will be approximately 25 residential fixture manufacturers, local contractors and distributors.

The Modern Living Show is the first public exposition to be held at McCormick Place, Chicago's new lake-front exposition center.

Teachers' Institute Held At Penn State

The College of Engineering and Architecture of The Pennsylvania State University, University Park, Pa., played host to educators from 50 universities for an institute on effective teaching for young engineering teachers, held August 29 to September 9. Conducted under the auspices of the American Society for Engineering Education and Engineers Council on Professional Development, the institute was supported by a grant from the Ford Foundation.

Purposes of the institute, attended by 25 engineering teachers with one to three years' experience and ten engineering teachers with ten or more years of experience, were to provide training in the fundamental principles and use of effective teaching methods, to orient young teachers to their profession as educators and to encourage research in methods to improve learning.

The two weeks of study, under the direction of Otis E. Lancaster, George Washington Professor of Engineering Education at Penn State, supported the view that mastery of his subject is the most important attribute of a good college teacher. There was equally strong evidence that knowledge of the principles of learning could add immeasurably to the creative powers of the teacher, and that the widespread application of these principles in engineering colleges could significantly upgrade the quality of students graduated at present.

Illumination Fundamentals Course Sponsored by New York Section

A basic course in the fundamentals of lighting design, considered from the practical standpoint of the engineer or designer in the field is being offered by the New York Section of IES. The course, divided into 12 sessions, is being conducted by members of the Section at the General Electric Auditorium in New York City. Fee is $15 for members of IES, AIA, AIEE, AID and employees of Sustaining Members; $20 for all others.

Program and instructors are:

September 19—Introduction to Illumination—H. Wald, Wald and Zigas, Consulting Engineers.
September 26—Light Sources, Incandescent—D. Lowe, General Electric Large Lamp Department.
October 3—Light Sources, Fluorescent—D. Lowe.
October 10—Light Sources, Fluorescent and Mercury—D. Lowe.
October 17—Control of Light, Principles and Methods—L. Goren, Globe Lighting Products.
October 24—Lighting Calculations—Point by Point and Lumen Method—E. L. Gluck, McPhilben Lighting Co., Inc.
October 31—Design of Interior Lighting Systems—L. Goren.
November 7—Problem Practice Session—Luminous Ceilings—E. L. Gluck.
November 14—Problem Practice Session—R. Wissoker, Day-Brite Lighting, Inc.
November 21—Lighting as an Art Form—R. G. Williams, Century Lighting, Inc.
November 28—Economics and Maintenance—R. Wissoker.
December 5—Challenge of the Lighting Industry—To be announced.

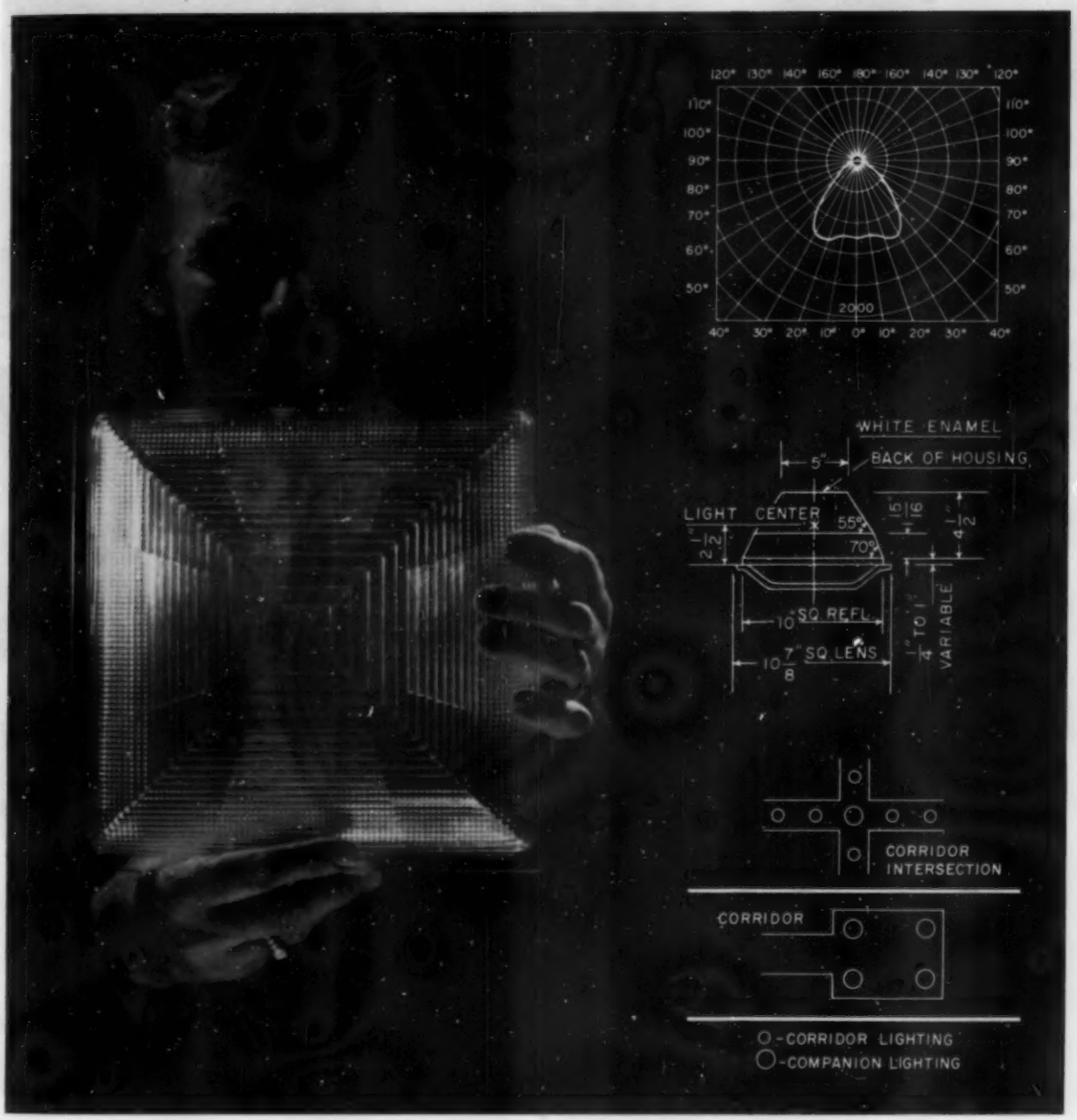
Douglas Lowe is serving as coordinator for the course. Text to be used is the *IES Lighting Handbook*, Third Edition.

13 Counties Propose Joint Road Safety Research Body

A recommendation for the establishment of an international organization for research in road safety was the major action taken at an international meeting of road safety experts held at the United Kingdom Road Research Laboratory, Langley, Buckinghamshire. The proposed international body would be responsible for coordinating research in member nations, fostering the interchange of road research information and recommending new research on problems which require, or would benefit from, international cooperation.

The meeting, held under the auspices of the European Productive Agency of the Organization for European Economic Cooperation, was attended by representatives of 12 European nations and the United States. Those represented included: Austria, Belgium, Denmark, France,

(Continued on page 14A)



NEW CORNING TEMPERED SQUARE CONVEX LENS FOR GENERAL AREA LIGHTING

This new lens from Corning gives soft, even light at corridor intersections and other open areas.

It lets you have uniform lighting design, too, because it was developed as a companion piece for the Tempered Corridor Lenslite.

The new No. 544201 Tempered PYREX® Square Convex Lens is three to four times stronger than ordinary annealed ware because it's *fully tempered*. It resists impact and won't break because of heat shock with any lamp up to 300 watts.

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It takes a C-201 Specular Alzak Reflector as does the Lenslite.

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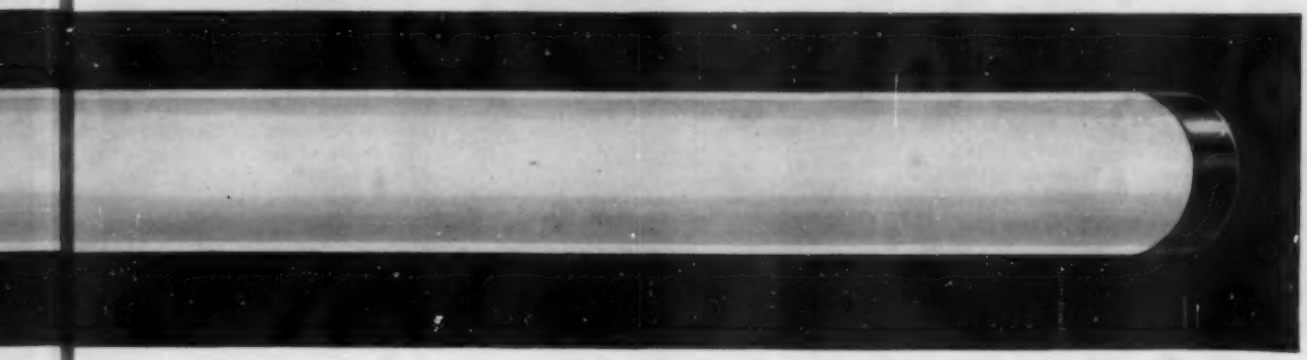

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WESTINGHOUSE LAMP DIVISION
Westinghouse Electric Corporation, Bloomfield, N. J.

(*Continued from page 10A*)

Greece, Italy, Norway, the Netherlands, Spain, Sweden, Switzerland and the United Kingdom. Sir William Glanville, director of road research in the United Kingdom, was chairman of the meeting.

Among the research problems which the delegates felt would benefit from international cooperation were: priority rules for vehicles meeting at intersections; road furniture (lighting equipment, sign posts, etc.); effects of speed limits on accidents and comparison of results of accident investigations in various countries.

Chicago Lighting Institute Offers 2 Fundamentals Courses

The annual fall courses in the fundamentals of lighting and wiring design given by the Chicago Lighting Institute began on October 3. Lighting Fundamentals, Raymond E. Wozniak, instructor, is composed of 12 lectures and six laboratory sessions. Wiring Design No. 1, Frank R. McShane, instructor, is a series of 12 lectures.

Programs include:

Lighting Fundamentals—light and sight; illumination design; office, school, industrial, store and residential applications; floodlighting; wiring for lighting; economics of lighting; illumination terms and light sources.
Laboratory—basic laboratory; brightness and visibility meters; incandescent lamp characteristics; lighting survey; light distribution curves and luminaire evaluation.
Wiring Design—electrical fundamentals; electrical formulas; wiring codes; electrical conductors; electrical systems; parts of wiring systems; wiring materials; designing lighting wiring systems; residential, commercial and industrial wiring.

Lectures in each course are held weekly; laboratory sessions twice a month. Tuition fee is $25 per course.

Lighting Price and Data Book Now Being Published

National Price Service has recently been expanded to include a new price and data book devoted exclusively to lighting equipment. "Lighting," as the publication has been named, will list nationally distributed brands of commercial and industrial equipment, including fluorescent and incandescent fixtures, floodlighting and accessory equipment.

The book will contain price sheets, equipment data, alphabetically-tabbed divider sheets and instruction sheets, and a special section of reference data for use in lighting design and layout. The format of the listings and drawings used to illustrate each item is similar to that used in the other two National Price Service publications for electrical construction materials.

Current price and listing information in each of the price books is maintained by the immediate revision and reissue of any sheet on which a change occurs.

Subscription fee for "Lighting" is $12 quarterly. Further information is available from the publisher, Henderson-Hazel Corp., 13609 Euclid Ave., Cleveland 12, Ohio.

1959 CIE Proceedings Now Published

The *Proceedings* of the 1959 Technical Sessions of the Commission Internationale de l'Eclairage, held in Brussels, Belgium, June 15-24, 1959, are now available. The contributions from more than 500 delegates from 24 countries have been organized into four volumes:

Volume A (212 pages)—*Sources of Radiation*—Photometry, Colorimetry. This volume also contains the minutes of the General Meetings.
Volume B (160 pages)—*Lighting Technology*—Lighting and Vision, Daylighting, Lighting Education.
Volume C (148 pages)—*Lighting Applications*—Dwellings, Schools, Industry, Mines, Ships, etc.
Volume D (96 pages)—*Lighting For Transport*—Streets and Roads, Automobile, Aviation, Light Signalling.

Price of the set of four volumes is $20, f.o.b. destination. Orders should be sent to: Mr. T. D. Wakefield, Treasurer, U. S. National Committee, CIE, The Wakefield Co., Vermillion, Ohio. Since there are only a limited number of sets of the *Proceedings* available, orders will be filled on a first-come-first-served basis.

Obituary

Benjamin S. Pritchard died of cancer on August 25 in Columbus, Ohio at the age of 37. He had been ill for many months. At the time of his death, he was a Research Associate at the Institute for Research in Vision at The Ohio State University where he was associated with Dr. H. Richard Blackwell.

Mr. Pritchard was responsible for much of the work done by Dr. Blackwell and his associates in establishing a scientific basis for the IES recommended levels of illumination. He developed the Visual Task Evaluator and made measurements of the original 56 representative visual tasks upon which the IES application committees based their recommended footcandle levels. He was also responsible for the development of a precision photoelectric brightness meter capable of measuring brightnesses of extremely fine detail or small objects at great distances.

Mr. Pritchard was the first to develop Dr. Glenn Fry's schematic diagram of a photoelectric disability glare meter into a practical form for field use. Subsequently, he developed a lens for the Pritchard brightness meter that would weight the light for various angles in proportion to the disability glare effect and, therefore, could be used as a simple accessory to the brightness meter in measuring disability glare.

Mr. Pritchard is also credited with the development of a procedure for the accurate measurement of specular reflection losses of printed and pencil-written material and contributed, in large part, to the investigation of several means of reducing losses of contrast due to specular reflection.

In the studies of fog on roadways, he carried out the work of determining the scatter effect of fog and developing and measuring means of increasing visibility through fog with proper control of light.

For his contributions to lighting research, Mr. Pritchard was awarded the Certificate of Distinguished Service by the Illuminating Engineering Research Institute last May.

Mr. Pritchard was an electrical engineering graduate of the University of Michigan in Ann Arbor.

ABOUT PEOPLE

Arthur I. Appleton, president of Appleton Electric Co., Chicago, Ill., has announced the appointment of **Murray J. Mauritzen** as vice-president in charge of manufacturing, effective September 1. Mr. Mauritzen has been connected with the organization since 1948, serving for the past three years as works manager.

Donald W. Gunn has been named as a regional vice-president of Sylvania Electric Products Inc., with responsibility for the direction of the company's marketing activities in 12 western states and Hawaii. Mr. Gunn, formerly vice-president—sales of Sylvania Electronic Tubes, will make his headquarters at Sylvania's distribution center in Burlingame, Calif. Also announced were three new appointments in Sylvania Lighting Products, a division of Sylvania Electric Products Inc. IES Fellow **George W. Clark** has been appointed marketing manager—fixtures, with responsibility for the design and manufacturing specifications of luminaires as well as for the development of photometric and other application data. Mr. Clark, who will continue to make his headquarters in Wheeling, W. Va., succeeds **Myles S. Gaythwaite. Richard G. Slauer,** president of IES, has been named as manager of engineering—fixtures. Mr. Slauer, who will be headquartered in Wheeling, has been associated with Sylvania since 1944, during which time his work has included specialization in minia-

(*Continued on page 17A*)

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(Continued from page 14A)

ture, photoflash, fluorescent and mercury lamps, activities in all phases of lighting fixtures and assignments involving industry training and public education on various lighting matters. **James P. O'Brien** succeeds **Walter K. Anderson** as manager of equipment development. Mr. O'Brien, who will work out of Salem, Mass., served until recently as manufacturing superintendent of the Sylvania fluorescent lamp plant in Danvers.

Stanley S. Sievers has joined Pelco Sales, Gardena, Calif., as vice-president in charge of marketing. Prior to joining Pelco, Mr. Sievers was associated with the closed-circuit television equipment industry in a marketing—application engineering capacity.

Recently announced by General Electric, Schenectady, N. Y., was the appointment of **O. L. Shay** as manager—switchgear sales for the Medium Voltage Switchgear Department, Philadelphia, Pa. In his new capacity, Mr. Shay will be responsible for all of the department's metal-clad switchgear substation, master-unit substation and rollout switch and fuse equipment sales to utility and industrial customers. G-E also announced the appointments of **Robert J. Guidera** as product sales engineer for the Hickory, N. C. plant of the Distribution Transformer Department and of **Raymond E. O'Keefe** as manager of original equipment manufacturer sales, Specialty Transformer Department, Fort Wayne, Ind.

The election of **Howard H. Sheppard,** vice-president of the Utilities and Power Department of Rumsey Electric Co., Philadelphia, Pa., as vice-president of the American Institute of Electrical Engineers, representing the Middle Eastern District, has been announced by the Institute's Board of Directors. Mr. Sheppard will fill the unexpired term of **D. L. Greene,** who has been named superintendent of transmission for Gilbert Pacific Inc., with headquarters in Okinawa.

Will Carlton has been named as executive secretary of the National Association of Lighting Maintenance Contractors, according to an announcement by Melvin H. Galbraith, Association president. Mr. Carlton will work out of the recently established headquarters office at 2120 Keith Building, Cleveland, Ohio.

The Sales Division Executive Committee of the Edison Electric Institute will be headed by **Claude D. Lawrence,** vice-

(Continued on page 20A)

SCHEDULED EVENTS

October 16-22, 1960—Society of Motion Picture and Television Engineers, Semi-Annual Convention, Sheraton Park Hotel, Washington, D. C.

October 19, 1960—Society of Plastics Engineers, Tooling for the Plastics Industry, New York, N. Y.

October 23-27, 1960—National Electrical Contractors Association, Las Vegas, Nevada.

October 25-27, 1960—American Standards Association, National Conference on Standards, Sheraton-Atlantic Hotel, New York, N. Y.

November 14-18, 1960—National Electrical Manufacturers Association (Annual Meeting), Traymore Hotel, Atlantic City, N. J.

November 17-19, 1960—Canadian Electrical Association, Engineering Sections, Western Zone, Saskatchewan Hotel, Regina, Sask.

November 21-23, 1960—Canadian Electrical Association, General and Sales Sections, Western Zone, Palliser Hotel, Calgary, Alta.

November 27-December 2, 1960—American Society of Mechanical Engineers, Annual Meeting, Statler-Hilton Hotel, New York, N. Y.

November 29, 1960—American Institute of Consulting Engineers, Annual Dinner, Waldorf-Astoria Hotel, New York, N. Y.

December 4-7, 1960—American Institute of Chemical Engineers, Annual Meeting, Statler Hotel, Washington, D. C.

December 5-9, 1960—National Conference on Application of Electrical Insulation, Conrad Hilton Hotel, Chicago, Ill.

January 23-26, 1961—Plant Maintenance and Engineering Show, International Amphitheatre, Chicago, Ill.

January 24-27, 1961—Society of Plastics Engineers, Inc., 17th Annual Technical Conference, Shoreham and Park Sheraton Hotels, Washington, D. C.

February 5-11, 1961 — National Electrical Week.

February 13-16, 1961—American Society of Heating, Refrigerating and Air Conditioning Engineers, Semi-Annual Meeting, Conrad Hilton Hotel, Chicago, Ill.

February 26-March 1, 1961—American Institute of Chemical Engineers, National Meeting, Roosevelt Hotel, New Orleans, La.

March 2-4, 1961—Optical Society of America, Roosevelt Hotel, Pittsburgh, Pa.

April 4-6, 1961—St. Louis Board of Trade, Progress in Electrical-Electronic Equipment Exhibit, Exposition Hall, St. Louis, Mo.

April 5-7, 1961—American Institute of Electrical Engineers, Southeast Meeting, New Orleans, La.

April 10-11, 1961—Society of Naval Architects and Marine Engineers, Spring Meeting, San Francisco, Calif.

April 10-14, 1961—American Society of Civil Engineers, Phoenix Convention, Hotel Westward Ho, Phoenix, Ariz.

April 19-21, 1961 — American Institute of Electrical Engineers, Great Lakes District Meeting, Minneapolis, Minn.

April 20-21, 1961—Society of the Plastics Industry, Western Section Conference, del Coronado Hotel, Coronado, Calif.

April 30-May 4, 1961—Electrochemical Society Meeting, Claypool Hotel, Indianapolis, Ind.

May 8-11, 1961 — Society of Photographic Scientists and Engineers, Annual Conference, Binghamton, N. Y.

May 17-19, 1961—American Institute of Electrical Engineers, North Eastern District, Statler Hotel, Hartford, Conn.

May 22-25, 1961—American Society of Mechanical Engineers, Design Engineering Division Conference, Detroit, Mich.

June 5-7, 1961—Edison Electric Institute, Annual Convention, New York, N. Y.

June 5-9, 1961—Society of the Plastics Industry, National Conference, Commodore Hotel, New York, N. Y.

June 11-15, 1961—American Society of Mechanical Engineers, Semi-Annual Meeting, Statler-Hilton Hotel, Los Angeles, Calif.

June 18-23, 1961—American Institute of Electrical Engineers, Summer General Meeting, Ithaca, N. Y.

June 26-28, 1961—American Society of Heating, Refrigerating and Air Conditioning Engineers, Annual Meeting, Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

June 26-30, 1961—American Society for Engineering Education, Annual Meeting, University of Kentucky, Lexington, Ky.

Deadline Set for Discussion and Rebuttal Of Conference Papers

Discussion and rebuttal for papers presented at technical sessions of the Pittsburgh Conference must be submitted by December 1 for publication with the paper in ILLUMINATING ENGINEERING.

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One copy to Benjamin S. Benson, Jr., Chairman, Papers Committee, Benjamin Division, Thomas Industries, Inc., Des Plaines, Ill.

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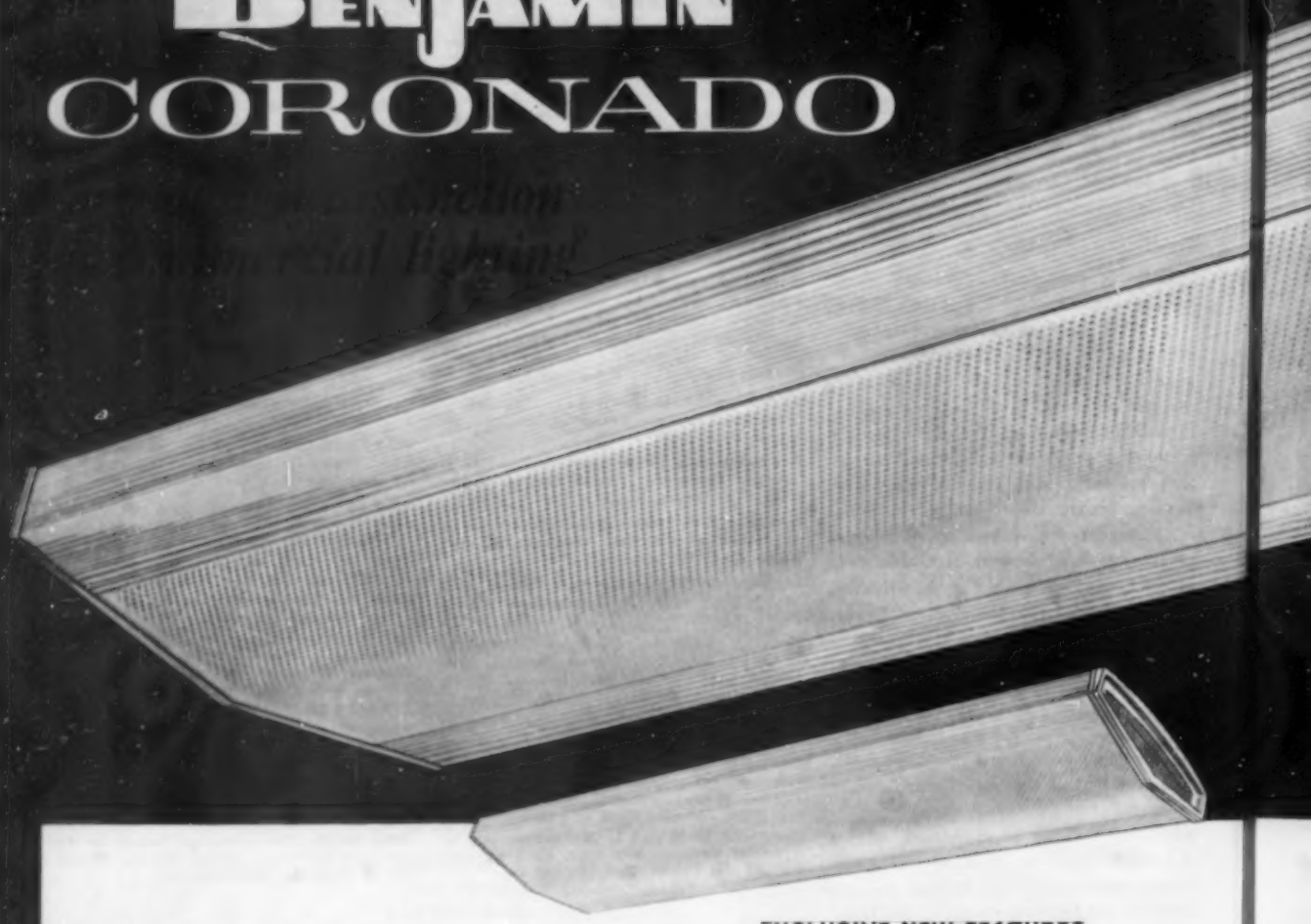

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NEW . . . finger-touch latch hinges from either side, allows basket to swing down or be removed—no tools needed.

NEW . . . snap-in wire way cover provides easy access to wiring and control equipment.

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NEW . . . one-piece "wrap-around" extruded plastic construction—only 2½" visible depth.

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CORONADO—CLEAR LENS (Top)

This new 3-in-1 diffuser boasts a crystal-clear L-120 low-brightness prismatic bottom, complemented by linear refracting lenses on sides and top to redirect light out of glare zone. Here is the ultimate in clear, color-stabilized polystyrene.

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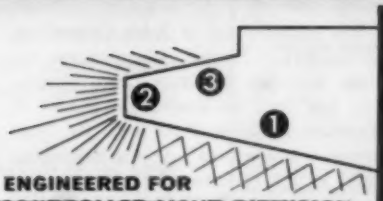

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NEW Toronto Chairman, A. W. Henschel (right in photo at left) receives reins of office from outgoing chairman, R. P. Lindsay at first 1960-61 meeting of Section's Board of Managers. L. to r., photo at right, Board of Managers at work: Harry Nellis, entertainment; Norman Bethune, publicity; Ed Bartley, education; Bus Brown, vice-chairman; Chairman Henschel; Lloyd Collins, membership; Keith Ormrod, secretary-treasurer. Standing over the group, outgoing chairman Lindsay. First regular Section meeting is joint meeting with Hamilton Chapter.

(Continued from page 17A)

president in charge of sales for the New England Power Service Co., Boston, Mass., for the coming year, according to an announcement by Sherman R. Knapp, president of EEI and president, Connecticut Light and Power Co., Berlin, Conn.

The Westinghouse Lamp Division has announced the appointment of **Frederick E. Nickel** as national account representative for the Central and Midwestern sales regions. Mr. Nickel, with headquarters in Detroit, will be responsible for lamp sales activities relating to nationally syndicated industrial accounts in his territory.

Timothy J. Allen has joined S. W. Brown, Consulting Engineers, New York City, as chief engineer—electrical. Formerly, Mr. Allen was associated with Voorhees Walker Smith Smith and Haines, Architects.

Gerald J. Gillen has been promoted to assistant manager of the Brooklyn District Office of the Consolidated Edison Co. of New York Inc. He was succeeded as supervisor of the Lighting Division by **Harold Peters,** Chairman of the New York Section of IES.

Union Carbide Plastics Co., a division of Union Carbide Corp., New York City, has appointed two new technical representatives in the North Central sales region, according to recent announcements by J. M. Herbert, regional manager of the concern. **John B. Hollingsworth** will cover the area from headquarters in Cleveland and **Arthur Knecssy** will work out of headquarters in Rochester, N. Y. Also announced was the appointment of **W. J. Prevost** as office manager of the Detroit District Office.

The appointment of **Charles Hitchcock** as lighting sales engineer to the Chicago area sales staff has been announced by Jules Pallagi, vice-president and sales manager of Alkco Manufacturing Co., Chicago. Mr. Hitchcock was formerly with Day-Brite Lighting Inc., Englewood Electric Supply and Commonwealth Edison.

Ernest F. Siegel has announced the opening of his office for the practice of consulting engineering in Baltimore, Md. Formerly, Mr. Siegel was chief mechanical-electrical engineer and Associate with Green Associates, Inc.

The appointment of **John Cummings** as California district sales manager for Halo Lighting Products, Inc., Chicago Ill., has been announced by Robert S. Fremont, president of the firm. Mr. Cummings, who has been active in developing sales at the distributor, contractor, and architectural levels for Halo for the past three years, will have his new headquarters in Los Angeles.

Mel G. Kennedy has been appointed as a director of the newly-expanded Electric League of Southern California in Los Angeles. Among Mr. Kennedy's responsibilities will be the development of a central group of members who will represent the entire electrical industry in Southern California. Prior to accepting his present position, Mr. Kennedy was manager of sales, marketing and public relations for EBASCO, New York management consultants.

The appointments of four new regional managers have been announced by A. F. Uhrlandt, director of field sales for the Crouse-Hinds Co., Syracuse, N. Y. **Robert I. Browning,** formerly a product engineer in the firm's San Francisco office, has been named as manager of the newly-created Pittsburgh Region. **Richard F. Kidwell,** with headquarters in Albany, and **James E. Blake,** of Ramsey, N. J., will head the Central New York and New York Regions, respectively. Managership of the Charlotte, N. C. Region will be assumed by **Jay M. Witbeck,** who joined the company in 1950 as a product engineer.

N-L Corp., Cleveland, Ohio, has announced the appointment of several new sales representatives. Those named are: **Burt Schwartz,** San Diego, Calif.; **Paul Kyack,** Philadelphia, Pa.; **Harold Guse,** Camp Hill, Pa.; **Richard Y. Fernandez,** Madeira Beach, Fla.; **Norman E. Nuss,** Pittsburgh, Pa., and **W. D. Osborn,** Phoenix, Ariz.

Henry Gluck, vice-president in charge of sales, Sunbeam Lighting Co., has announced the appointment of the recently-established Duke-Philibert and Co. as Louisiana representative. Duke-Philibert, with **Robert A. Philibert** working out of New Orleans and **William M. Duke** headquartered in Baton Rouge, will handle all sales activity for Sunbeam in central and southern Mississippi as well as in Louisiana.

Death

Robert P. Woody, Capital Section.

keeps other lamp burning should one lamp fail

Sola's new weatherproof 400-watt 2-lamp parallel transformer puts an end to double outages. Because its circuit provides complete electrical independence between the two lamps, with negligible interaction, the failure of one lamp does not significantly affect the operation or light output of the remaining lamp. Sola's proven constant wattage principle insures a regulated, safe power flow to the remaining lamp — guards against damage from current surge.

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The case features a new kind of weatherproof seal to insure a positive fit with normal case expansion and contraction. Under ambient temperature changes severe enough to crack a solder seal, this flexible plastic gland "gives" to keep the seal tight and protect against moisture penetration to the internal components.

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Primary Voltage	Cat. No.	Min. Start. Temp. °F.	Wt. Lbs.	Diam. in.	Ht. in.
100-130/200-260	77-10-246	–20	47	6⅝	12
180-235	77-15-246	–20	47	6⅝	12
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200-260 x 400-520	77-11-246	–20	47	6⅝	12

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(*Continued on page 26A*)

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(Continued from page 23A)

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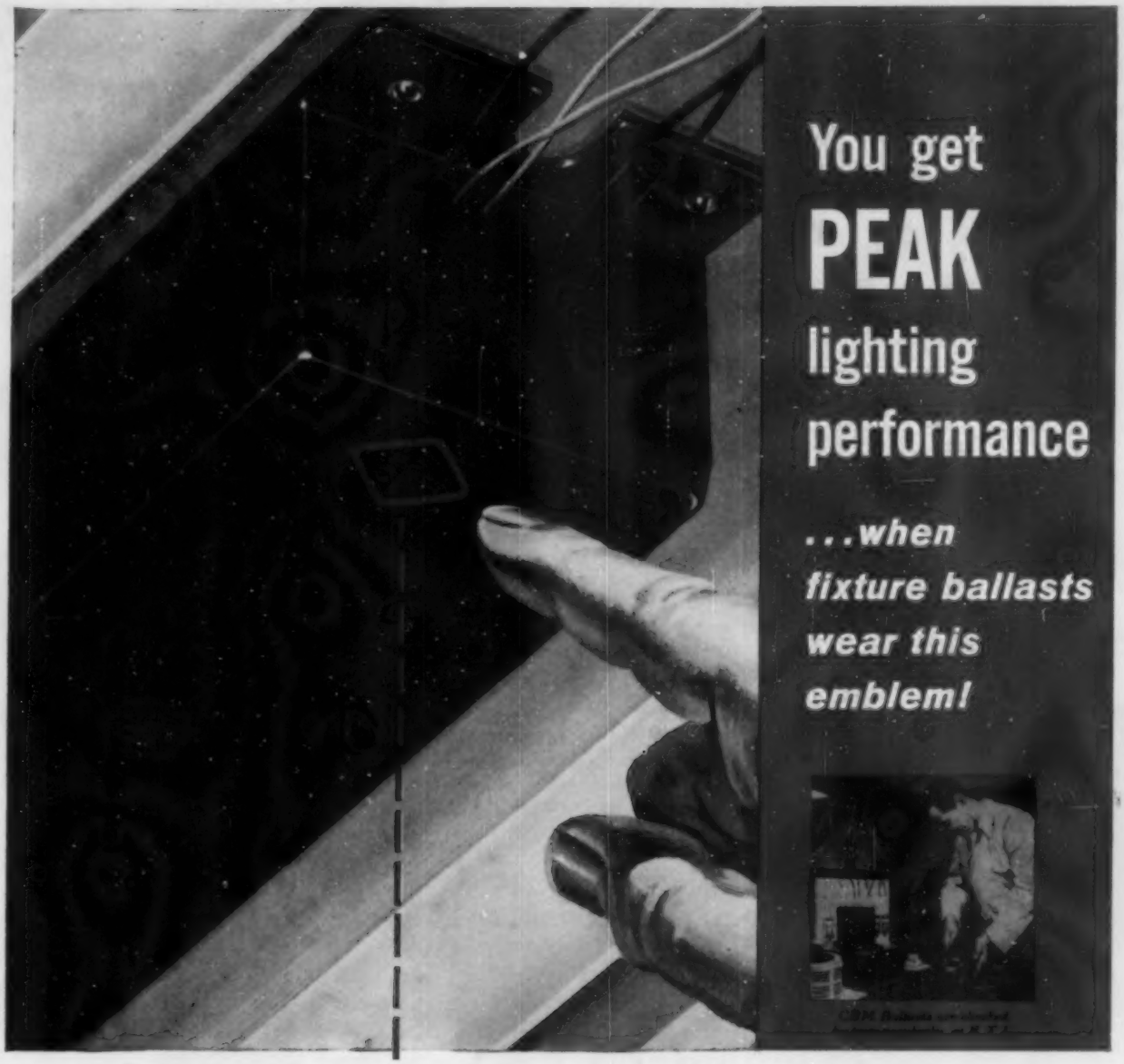
(Continued on page 40A)



You get PEAK lighting performance

...when fixture ballasts wear this emblem!

...And that's only one of the many advantages this emblem assures you!

CBM CERTIFIED by ETL

Because "CBM Certified" means fluorescent lighting ballasts engineered for dependable service. They have to be . . . to meet CBM "specs"! Result: Practical benefits for you . . . that include longer ballast life . . . up to 2500 hours more lamp life . . . power factor correction . . . and positive starting. You get savings in installation, too, since fixtures with CBM ballasts mean fewer circuits needed. And you get the assurance of perfomance checked by ETL test, plus UL listing. Ask for CBM ballasts on fixtures you sell or specify. And to keep up-to-date on ballast facts, ask us to send you "CBM NEWS".

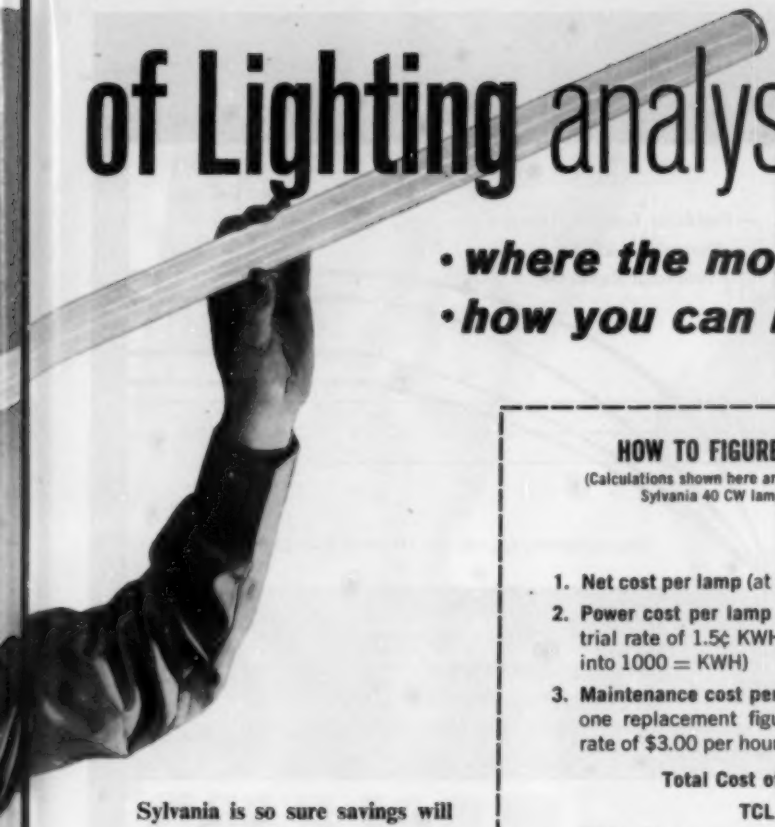
Participation in CBM is open to any manufacturer who wishes to qualify.

CERTIFIED BALLAST MANUFACTURERS, 2112 KEITH BUILDING, CLEVELAND 15, OHIO

If you just figure
the cost of lamps
you only know about
1/10th of the story!
Only a Total Cost
What about
cost of
power?
What about
his time?
What about
cost of lamps?

# of Lighting analysis can show

- ***where the money really goes***
- ***how you can really cut expenses***



HOW TO FIGURE YOUR TOTAL COST OF LIGHTING (TCL)

(Calculations shown here are based on the average 7500-hour operating life of a standard Sylvania 40 CW lamp which requires 46 watts of power including ballast.)

	National average per lamp	Put your costs here
1. **Net cost per lamp** (at average discount of 35%)	$ .81	
2. **Power cost per lamp** based on average industrial rate of 1.5¢ KWH (watts × 7500 hours ÷ into 1000 = KWH)	5.18	
3. **Maintenance cost per lamp** (one cleaning plus one replacement figured at average industry rate of $3.00 per hour)	2.00	
Total Cost of Lighting (TCL) per lamp	7.99	
TCL for 100-lamp installation	$799.00	
(Note: If you use 100 Sylvania lamps, figure the 8% extra lighting value of 8 lamps over 100 ordinary lamps.*)	× .08	
Saving through extra Sylvania lighting value*	$ 63.92	

*These are the extra dollars you would have to spend per 100 ordinary lamps to get the equal lumen hours of light you get from Sylvania.

Sylvania is so sure savings will result from figuring this way, we'll even send our representative to show you how (or you can do it here—now!)

With cost of lamps amounting to only about 10% of your *T*otal *C*ost of *L*ighting (TCL), why should Sylvania be so interested in this new over-all way of figuring? Two good reasons:

First, because TCL best demonstrates the over-all superiority of Sylvania fluorescents.

Second, because we believe that just in figuring TCL you'll discover a number of new opportunities for shaving costs. And that's one of the things we like to help you do.

What *is* your TCL? Cost of lamps *plus* power *plus* maintenance. Add cost of fixtures, too, if you're remodeling.

WITH TCL ANALYZER, a Sylvania representative can figure in minutes how the special conditions in your plant affect Total Cost of Lighting.

Our representative can help figure special conditions in your plant. With his Analyzer Kit, he can do it in minutes, give you a complete lighting analysis *free*.

He can also show you how and why, for every penny you spend for lamps, power and maintenance, you get more value with Sylvania.

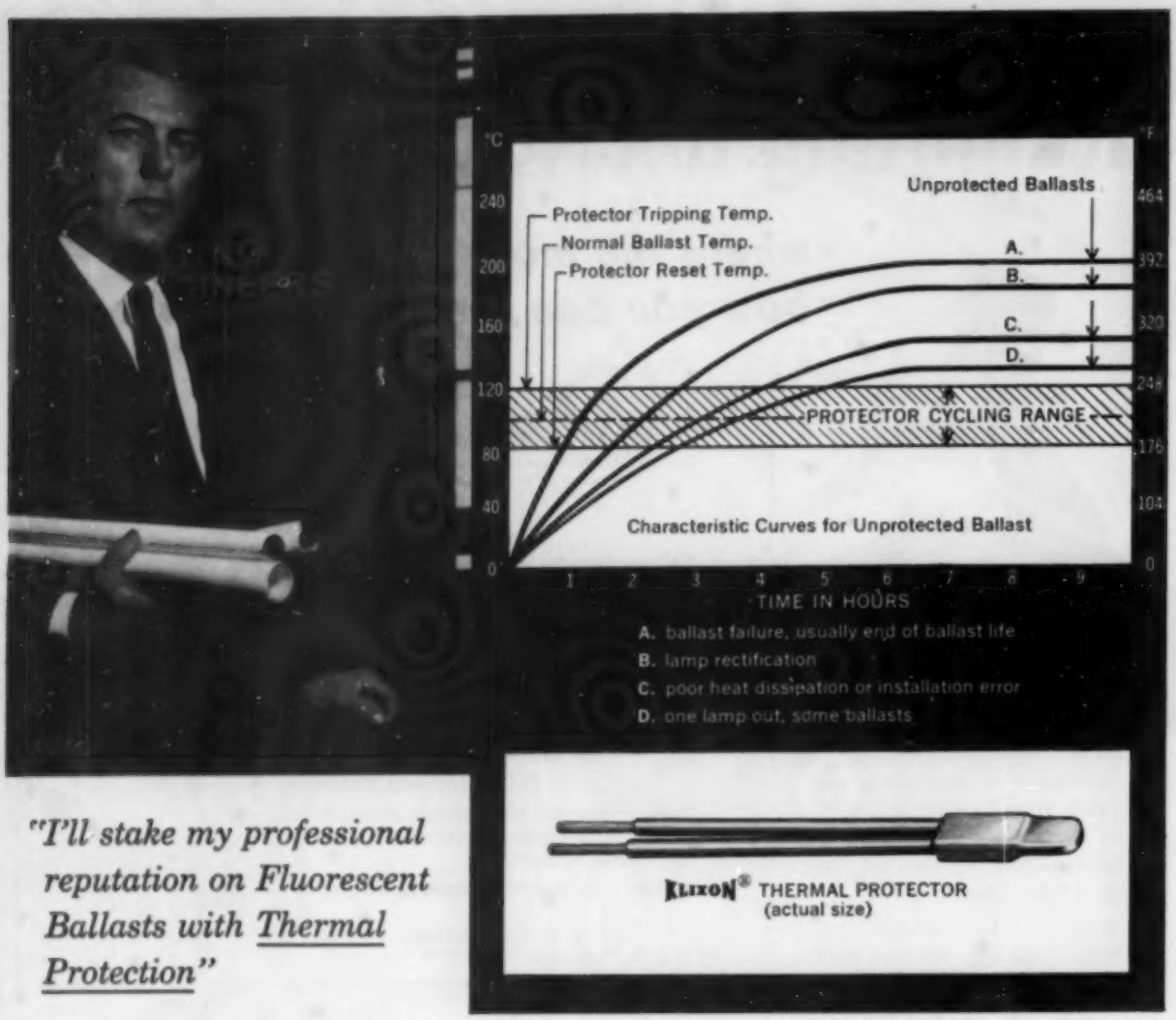
And he'll show how Sylvania backs its claims to lowest TCL with an *exclusive* Light Insurance Policy. *Guarantees* Sylvania fluorescents will perform better *in your own opinion* than the brand you are now using—or your money back!

Call your Sylvania representative. Or write us: Sylvania Lighting Products, a Division of Sylvania Electric Products Inc., Dept. 61, 60 Boston St., Salem, Mass. In Canada: Sylvania Electric (Canada), Ltd., Box 2190, Station "O," Montreal 9.

EXCLUSIVE SYLVANIA LIGHT INSURANCE POLICY is your guarantee of lowest TCL—or your money back!

SYLVANIA

Subsidiary of **GENERAL TELEPHONE & ELECTRONICS**



"I'll stake my professional reputation on Fluorescent Ballasts with Thermal Protection"

That is a sound viewpoint for any Electrical Engineer to take because when he specifies thermally-protected ballasts —

he is assured of . . . properly operating ballasts, fixtures and installation within U/L temperature limits — because a protector properly applied to a ballast will keep the ballast operating within a safe temperature range under all conditions. (see chart).

he is assured that . . . faults will be discovered while the contractor is still on the job equipped to make corrections.

he is assured of . . . normal ballast life when a fault is corrected if the cause of over-temperature is external to the ballast — if the fault is in the ballast, temperature limits are held to a safe level until it is convenient to change the ballast.

he is assured that . . . no dripping, fires or violent failures will occur at the end of ballast life.

These are important benefits to you and to your clients. They are easy to get. Simply use the specifications shown here. Ballasts equipped with KLIXON Protectors can be supplied to your fixture manufacturer by all six leading makers of ballasts. Write for full engineering details.

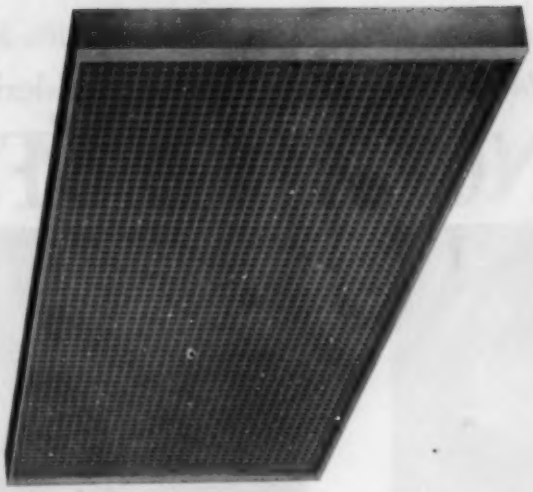
USE THIS THERMAL PROTECTION SPECIFICATION

"Ballasts shall be thermally protected against overheating by a built-in overheat protector sensitive to both winding temperatures and current which will prevent winding temperatures from exceeding 120° C. with the exception that the peak temperatures in the first few cycles may exceed this. The protector must allow the winding temperatures to reach 105° C. minimum under normal conditions in a 40° C. ambient without opening the circuit to the primary winding, and after opening shall not reclose above 85° C. Fixtures must be so designed that ballast coil temperatures shall not exceed the U/L limit of 105° C. in a 40° C. ambient".

TEXAS INSTRUMENTS
INCORPORATED
METALS & CONTROLS DIVISION
5410 FOREST STREET • ATTLEBORO, MASS.

SPENCER PRODUCTS: Klixon® Inherent Overheat Motor Protectors • Motor Starting Relays • Thermostats • Precision Switches • Circuit Breakers

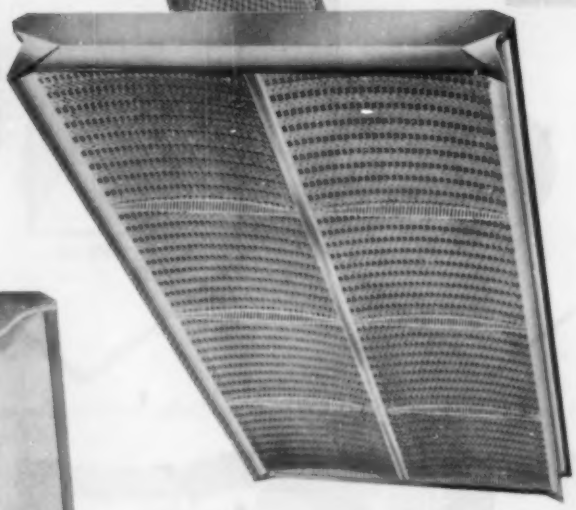
QPLM6500 for thin-lined architectural appeal.

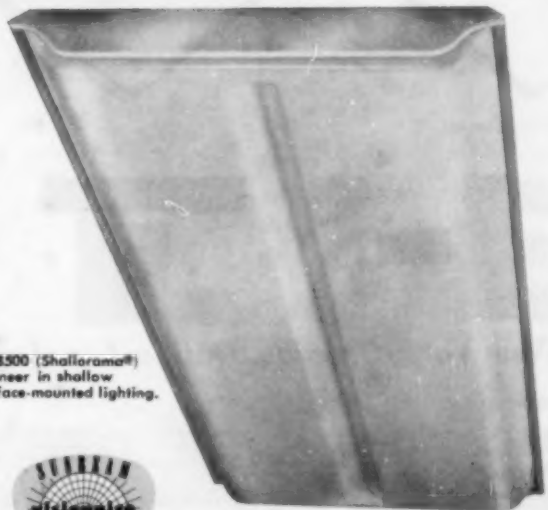


QPCX7400 "Wrap-around" all-plastic enclosure.

QRH7500 (Sculpturama®) with all-curved styling.

QUICK CHANGE LIGHTING





QP8500 (Shallorama®) pioneer in shallow surface-mounted lighting.

Adaptability for future change is a basic design principle in back of Sunbeam Lighting fixtures. For instance, when you specify and install the ultra-shallow, surface-mounted Visionaires® #6500, #7400, #7500 or #8500 you are automatically planning ahead. The diffusers to these versatile series are all interchangeable. They give the building owner a wide choice of 16 different lighting possibilities when planning alterations. He might select QP8500 (Shallorama®) because of its recessed look and wide light distribution, QRH7500 (Sculpturama®) with the sculptured look and which is unexcelled in low brightness control or the QPCX7400 ("Wrap-around") with exclusive SUNLUX® plastic enclosure for soft diffusion. A quick change in lighting is as simple as the unique, tool-free, "hook-on" hinging arrangement can make it. Merely change the framed diffuser!

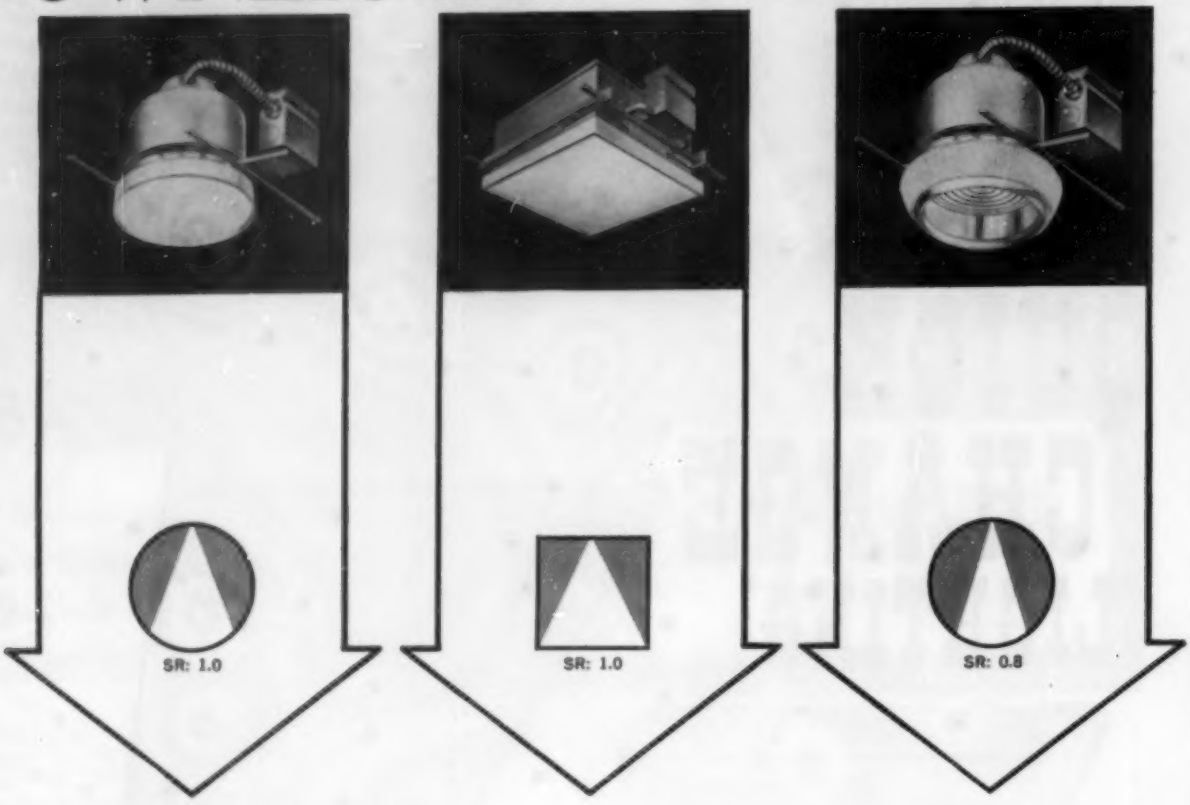
Investigate how Sunbeam Lighting today can save tomorrow!

SUNBEAM LIGHTING COMPANY

777 East 14th Place, Los Angeles 21, California — 3840 Georgia Street, Gary, Indiana

This is the embodiment of a design philosophy . . . a blending of function with aesthetics . . . a precisely engineered approach to every downlighting need. The product is *Calculite,* an impressive collection of 18 models of recessed incandescent fixtures . . . a total of 96 sizes and finishes, shapes and capacities. Each is designed for a *predictable* lighting effect, a particular design

DOWNLIGHTING EFFECTS



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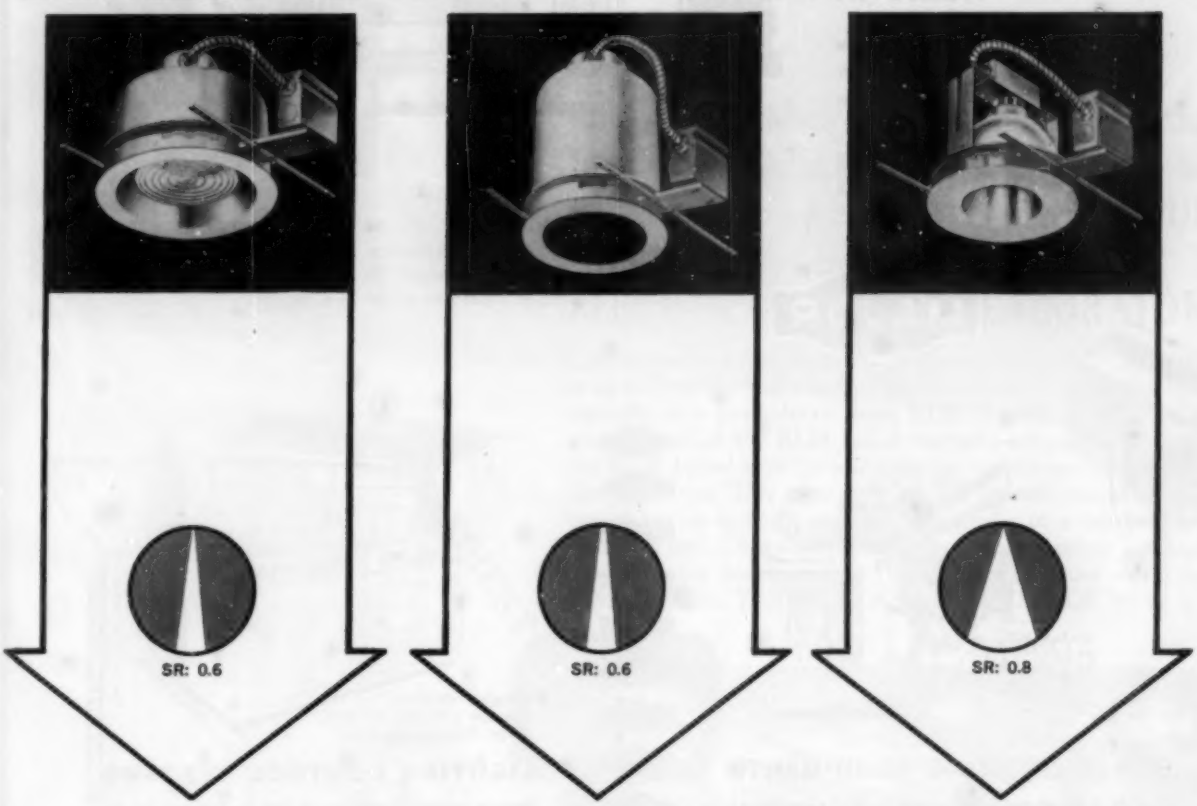

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...for a better way of Light

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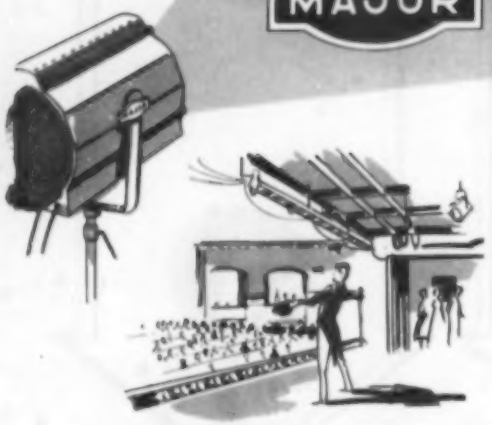

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Over 40 years of *specialized* stage lighting experience have proven the MAJOR equipment to be superior in every respect. It has met the exacting stage lighting requirements for theatres, auditoriums, churches, schools and TV studios all over the country.

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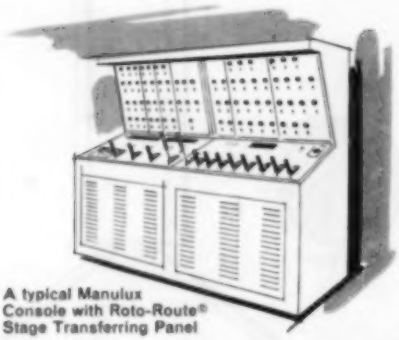

A typical Manulux Console with Roto-Route® Stage Transferring Panel

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Deluxe, custom switchboards and control systems for the smallest cocktail lounge to the largest auditorium are designed and engineered by MAJOR. *Whatever* your lighting control problem, write or call MAJOR for professional assistance.

4 Basic Systems:

- Major Modulite Mark II System
- Major Modulite System
- Major Varilux System
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MAJOR

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4603 Fullerton Ave., Chicago 39, Ill.
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In Theory Anyone Can Make Lighting Fixtures to RLM Standards

BUT

only RLM-Labeled fixtures are guaranteed to meet these standards, a guarantee made possible only by both the MANUFACTURER and the Certification Program of THE ELECTRICAL TESTING LABORATORIES

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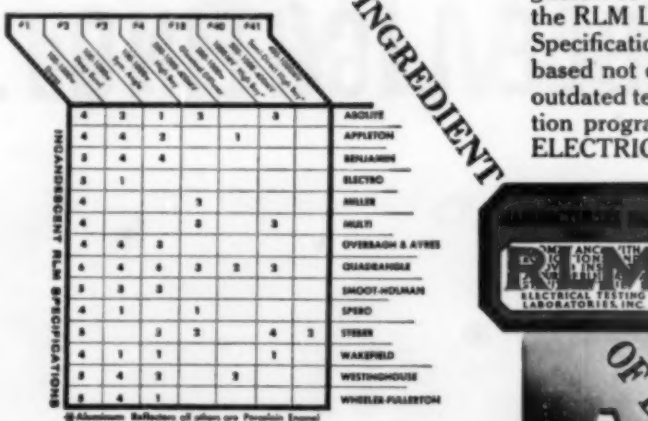
You often hear the question, "Is it equal to RLM?"... or you see in specifications the words: "RLM or Equal"... of course, theoretically it is possible to meet RLM Specifications. It is in the *guarantee* that the RLM Label cannot be equaled! The heart of the RLM Label is in its warranty of conformance to these RLM Specifications. This guarantee of the manufacturer to buyers is based not on specially submitted samples to a laboratory or an outdated test... but on a continuous, current testing and certification program conducted by the independent and world famous ELECTRICAL TESTING LABORATORIES OF NEW YORK.



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Types of RLM-Labeled equipment available from each of the 22 participating manufacturers is shown in the chart.

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LIGHTING QUALITY

These TWIN QQ's to Industrial Lighting Success are guaranteed with all lighting equipment bearing the RLM Label. Write for FREE RLM Specifications Book.

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In Detroit's New Cobo Hall

10 ACRES OF DRAMATIC AND FLEXIBLE LIGHTING.....b

The handsome front entrance of Cobo Hall, Detroit's exciting new Convention-Exhibition Hall.

Space limits a complete description of the Sylvania lighting installation at Cobo Hall. If you are interested in a full detailed report, it will gladly be sent on request. Simply write to Sylvania Electric Products Inc., Wheeling, West Virginia.

Giffels & Rossetti, Inc., Architects and Engineers
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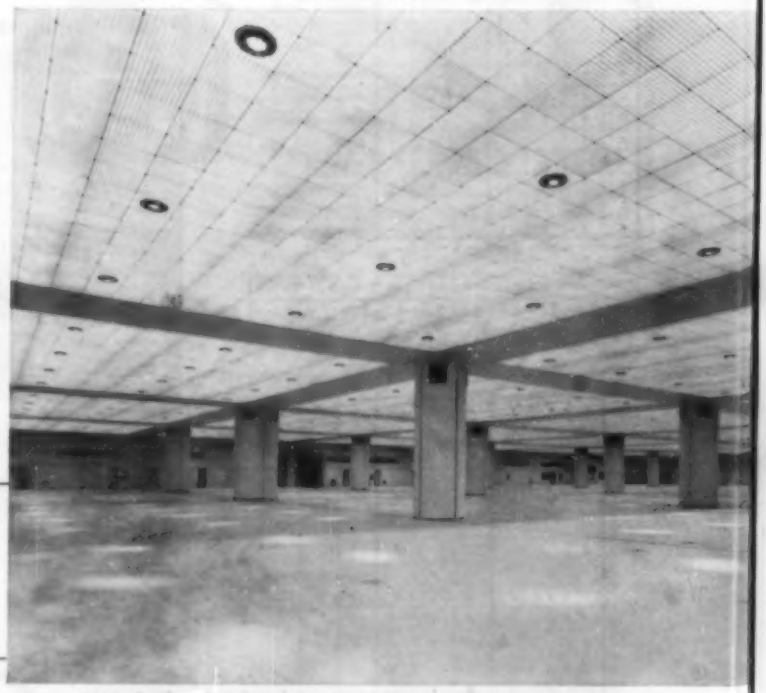
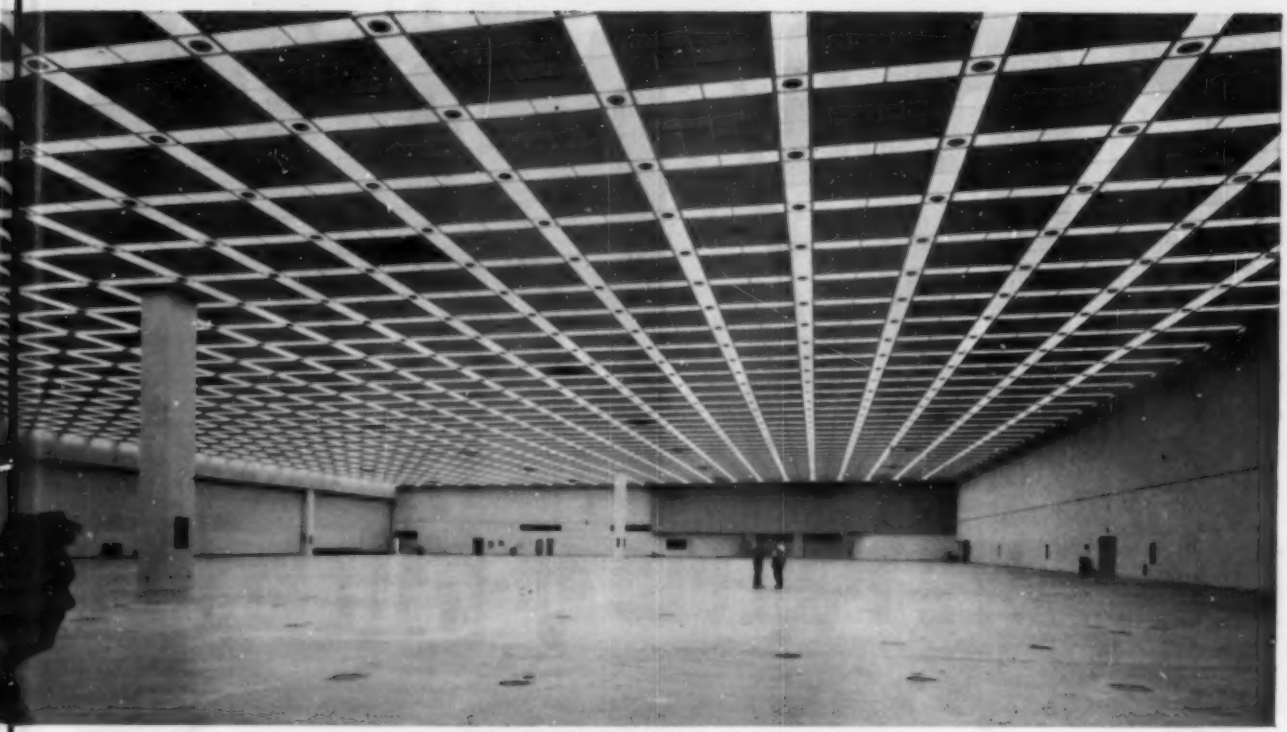


Sylvania's louvered ceiling provides 135 footcandles of general lighting for over 100,000 square feet of display area. Complete system consists of outrigger-type fixtures with eight 75-watt Instant Start lamps installed in a grid arrangement.



One of three 100,000 sq. ft. exhibit halls lighted with Sylvania's 2′ x 8′ and 2′ x 2′ Troffers in a modular pattern.

..by SYLVANIA

Cobo Hall, Detroit's new exhibition center, features one of the largest and most flexible lighting installations ever made.

On both floors of this vast exhibition hall Sylvania provides the versatile lighting needed for a wide variety of exhibition uses.

The three halls on the second floor, designed for the display of large equipment, each measure 240 feet wide by 405 feet long with a ceiling height of 30 feet. Each hall utilizes Sylvania's 2′ x 8′ lay-in Troffers and 2′ x 2′ recessed units in an attractive and eye-catching 10′ x 10′ modular pattern.

Through circuiting, six different general lighting levels up to 135 footcandles can be obtained. Keeping with the flexibility theme, each 2′ x 2′ unit contains fluorescent lamps for general lighting and one 500 watt incandescent swivel-type spot for highlighting exhibits.

On the first floor where smaller equipment will be displayed an entirely different lighting system is used. Sylvania's luminous louvered ceiling provides 2-level lighting control—either 70 or 135 footcandles—for over 100,000 square feet of display area. Again incandescent spots are installed on 14′ square modules to highlight displays.

This tremendous lighting installation illustrates Sylvania's ability to work hand in hand with architect, engineer and contractor on jobs of any size . . . from 10 square feet to 10 acres.

For your next lighting installation—check Sylvania first.

SYLVANIA LIGHTING PRODUCTS
A Division of SYLVANIA ELECTRIC PRODUCTS INC.
One 48th Street, Wheeling, W. Va.

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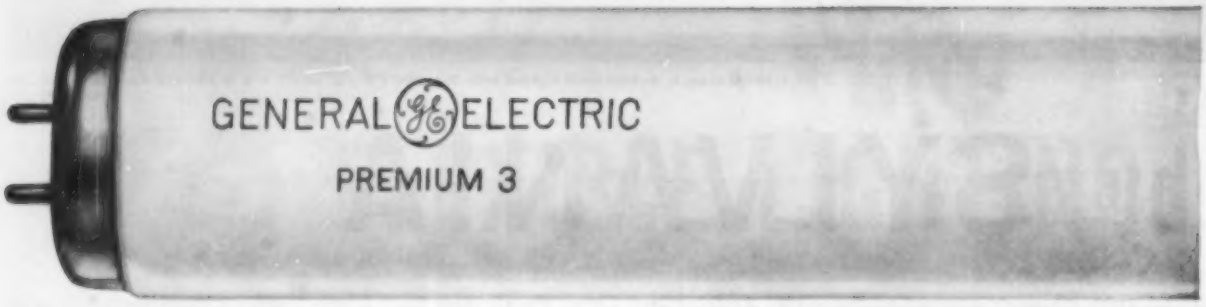

New G-E Premium 3 Fluorescents. If your customer's present 40-watt fluorescents are two years old or more, he can probably boost his lighting level by 30% to 50%—overnight—without spending a single capital expense dollar! How? By replacing the old fluorescents with new General Electric Premium 3 Lamps. Fact is, he'd gain *at least* as much extra light as his present lamps would deliver if they were a foot longer and used a lot more electricity.

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THE ALL WELDED STRUCTURE AND HIGH QUALITY ENAMELED FINISH ASSURE A LONG SERVICEABLE LIFE AT AN EXPENSE LEVEL COMPATIBLE WITH THE MOST MODEST LIGHTING BUDGET.

BUT DESCRIPTIONS ARE HARDLY ADEQUATE. YOU SHOULD SEE THE FIXTURE ITSELF. SAMPLES AVAILABLE AT USER'S COST OF $18.95.

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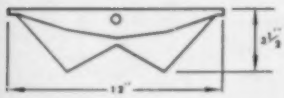
END PLATE CONSTRUCTION PROVIDES VIRTUALLY UNBROKEN ROWS OF GLOWING ILLUMINATION



OVERALL SIZE SHOWS COMPACTNESS AND RECESSED APPEARANCE OF UNIT.

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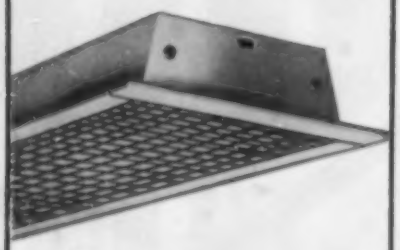

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(Continued from page 26A)

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(Continued on page 43A)

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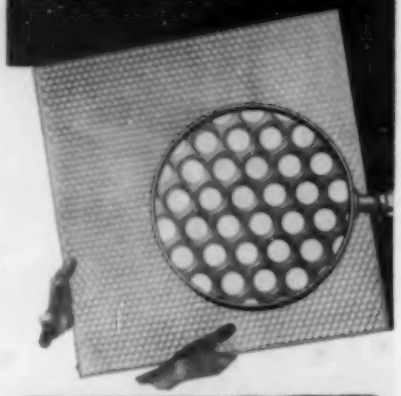

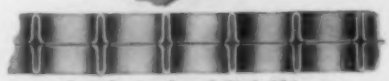

Cross Section through Circlgrid Louver

Nominal Sizes — 2' x 2' x ½"
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Translucencies — 300-150-75 FC

More than a Luminous Louver

- It's **UL** listed-**20** (non-combustible)
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As lighting specialists we developed Circlgrid to meet building lighting codes—it will not support combustion and is safely applied under sprinklers. Circlgrid is thermo-formed from two sheets of vinyl and fused electronically to a center vinyl membrane for structural strength and rigidity—yet weighs only 3½ oz./sq. ft. Many leading lighting equipment manufacturers are licensed to sell and distribute Circlgrid in USA, Canada and other countries.

The moment you see and inspect a Circlgrid sample you'll think of many applications in modern lighting.

Write for sample and technical data.

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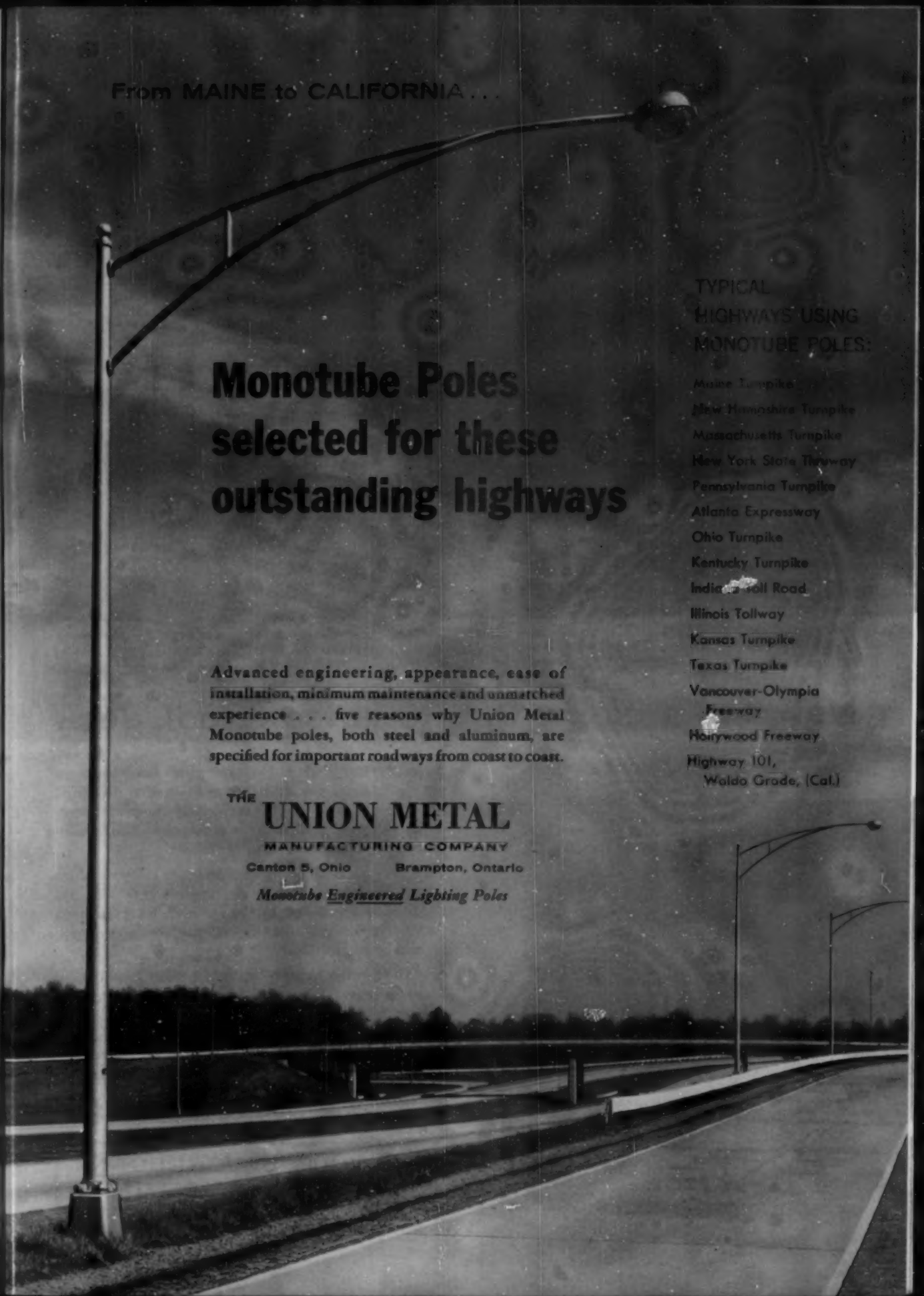
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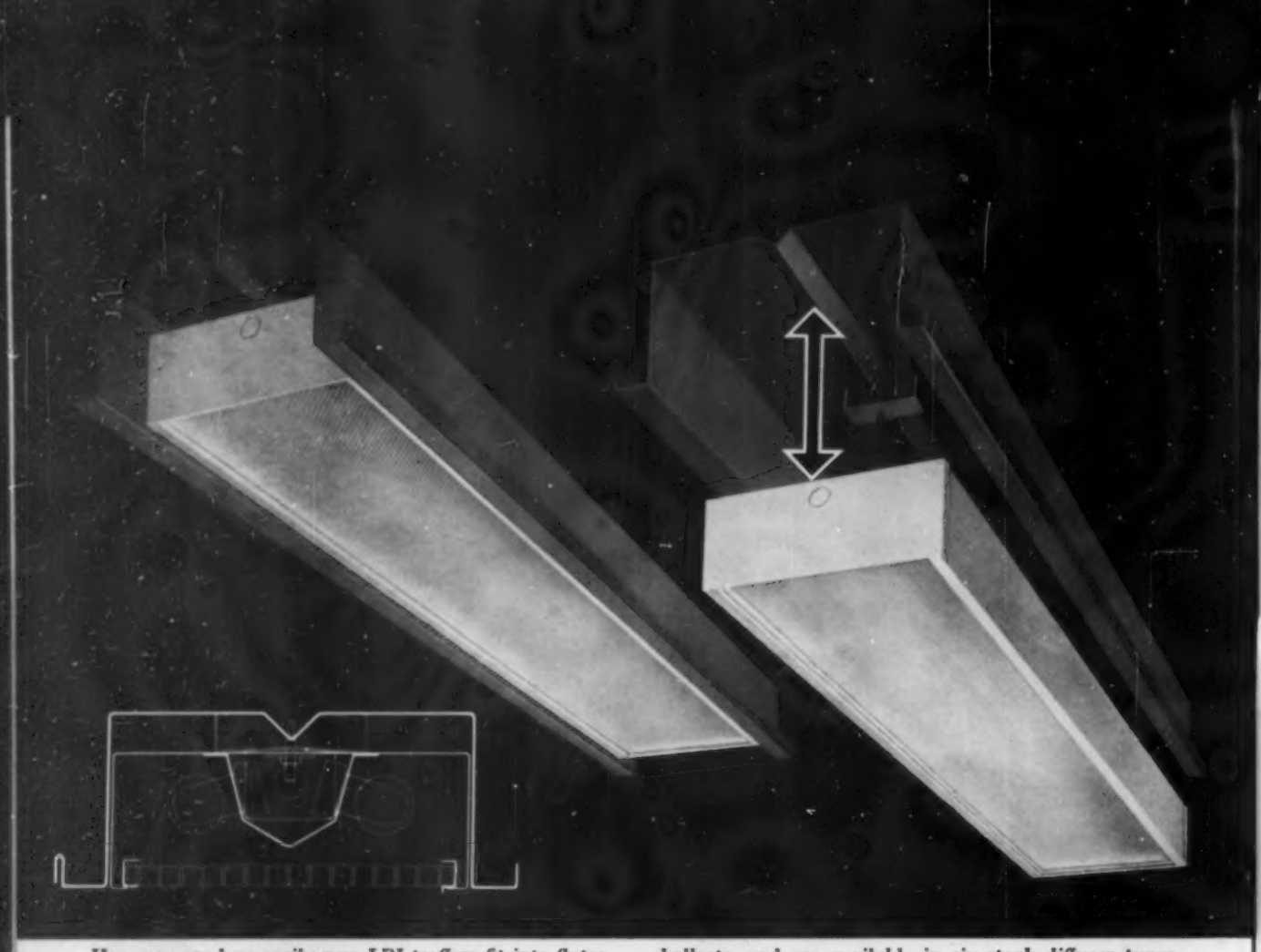

Here you see how easily new LPI troffers fit into flutes of Robertson Q-Deck. These rugged, die-formed steel fixtures are UL-listed with CBM-certified rapid-start ballasts, and are available in six stock diffuser types. Cross section shows simplicity of unit and convenience of installation. Troffers are wired complete, ready to go in.

New LPI troffers for Robertson roof deck

Note simplified treatment of the flush lighting. Adjacent cells can be closed off with acoustical ceiling material.

Versatile Robertson Q-Deck brings all the advantages of quick, clean, dry construction to modern buildings. LPI's new roof deck troffer is specially designed to combine with steel roof deck as a low-cost, functionally handsome ceiling and lighting system.

Architects, engineers, and contractors everywhere are discovering that the happy combination of Q-Deck and LPI troffers installed *within the cells* gives them an attractive low-cost lighting scheme for many new-construction situations.

Self-aligning hangers make for easy installation. Maintenance is simplified by easy-operating framed, hinged diffusers and by ready accessibility of all components. A wide choice of diffusers, including six stock models in formed acrylic, plastic louver, ventrolens, and glass, provides a selection of troffers for all applications.

For more information, write for Roof Deck Troffer Bulletin.

LPI FLUORESCENT LIGHTING

Lighting Products Inc., Highland Park, Illinois

(*Continued from page 40A*)

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(*Continued on page 44A*)

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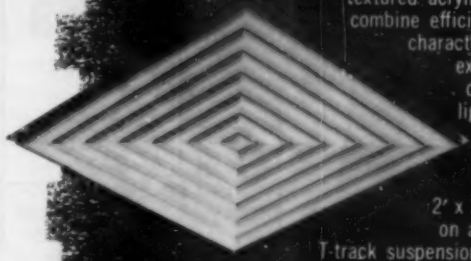
New architectural concepts utilizing sculptured decorative designs for luminous ceilings and other lighting applications are now possible with Acrilume Lighting Diffusers. These pre-formed diffusers of rich, textured acrylic composite combine efficient acoustic characteristics with excellent light diffusion and light stability.



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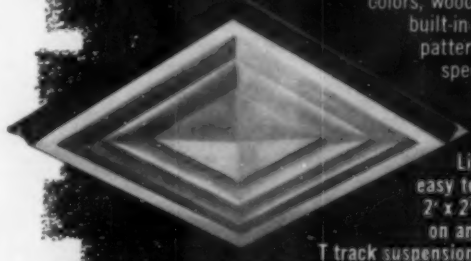

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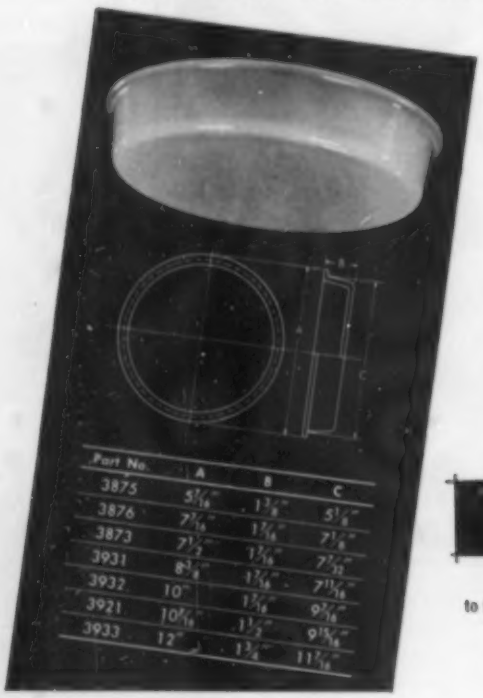

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(Continued from page 43A)

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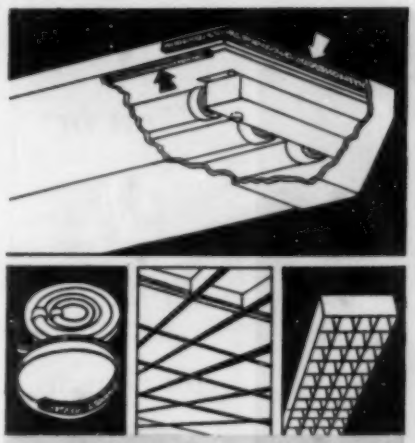

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FOAMSTIK provides resilient cushioning and good insulation between glass and frame of lighting fixtures and wherever desirable to seal out air, moisture, dust particles, insects. It helps keep mountings flush, secure to ceiling or wall. It protects against vibration and shock. Prevents loosening, slipping, rattling, swinging. Saves damage to parts, mechanisms, attachments such as brackets, latches, lamp holders, etc. Improves installation of luminaires, troffers, strip ceiling mounts, diffusers, reflectors, color filters.

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The specification type market is stressed due to our modern and complete, self-contained production facilities and experience in providing lighting equipment which will meet the strictest Architectural or Engineering requirement . . . from the complex, custom-designed in small quantities, to the large quantity competitively-priced unit.

Since our recent merger with a large electronics firm, it has been decided by Management to expand our national distribution in certain marketing areas in line with our expanded and accelerated production capability. Knowledge and experience in Sales-Engineering type contact with Architects, Engineers, Contractors, and Distributors is a prime requisite. Territorial coverage is being expanded on a national scale with many prime areas available. Please submit complete facts in first letter which will be held in strictest confidence. Address Box 456, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

CHIEF DESIGNER

One of the largest national manufacturers of quality lighting fixtures for commercial, industrial and institutional application. Must be conversant with all materials and technology pertaining to the design, development and manufacture of fluorescent lighting equipment. Should have creative ability. Locate in Southern California. Salary excellent, commensurate with experience. Send resume in confidence to Box 463, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, New York.

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By established national manufacturer of illuminated ceiling systems and specification quality fluorescent and incandescent lighting fixtures of all types. Factory located in Northeast; modern product line and new literature. Territory: NEW YORK STATE. Write full details to Box 462, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

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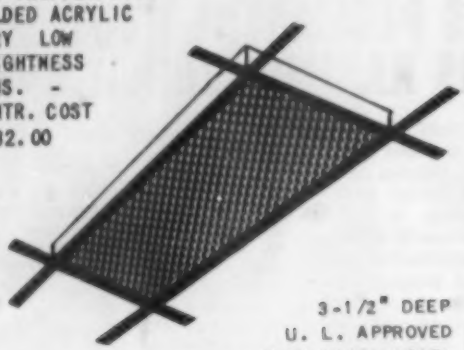

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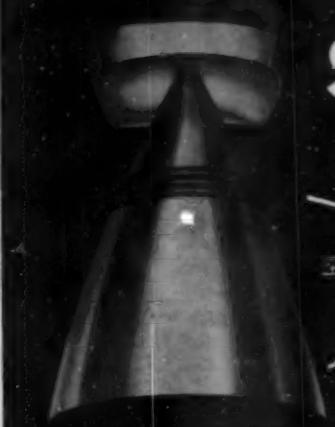
INDEX TO ADVERTISERS
October 1960

Advance Transformer Co.	1A
American Louver Co.	Inside Back Cover
Benjamin Div., Thomas Industries Inc.	18A-19A
Butler Lighting	46A
Certified Ballast Manufacturers	27A
Cirvac Plastics	40A
Contrex Co.	43A
Corning Glass Works	11A
Day-Brite Lighting Inc.	4A-5A
E. I. du Pont de Nemours & Co. (Inc.)	24A-25A
General Electric Co., Lamp	38A
Edwin F. Guth Co.	Back Cover
Keystone Electric Mfg. Co.	2A
Kopp Glass Inc.	22A
Lancaster Glass Corp.	44A
Lighting Products Inc.	42A
Lightolier	32A-33A
Litecontrol Corp.	6A
Major Equipment Co., Inc.	34A
R. A. Manning Co.	46A
Meirjohan-Wengler	44A
Merix Chemical Co.	46A
Metalcraft Products Co. Inc.	40A
Modern Light Co. of St. Louis	39A
Monsanto Chemical Co.	48A
Precision Multiple Controls	46A
Revere Electric Mfg. Co.	8A
RLM Standards Institute	35A
Sheffield Plastics, Inc.	16A
Sola Electric Co.	21A
Stonco Electric Products Co.	47A
Sunbeam Lighting Co.	31A
Sylvania Electric Products Inc.	28A-29A, 36A-37A
Texas Instruments Inc., Metals & Controls Div.	30A
Union Metal Mfg. Co.	41A
United Mineral & Chemical Corp.	45A
Universal Mfg. Corp.	15A
Wakefield Co.	Inside Front Cover
Westinghouse Electric Corp., Lamp Div.	12A-13A



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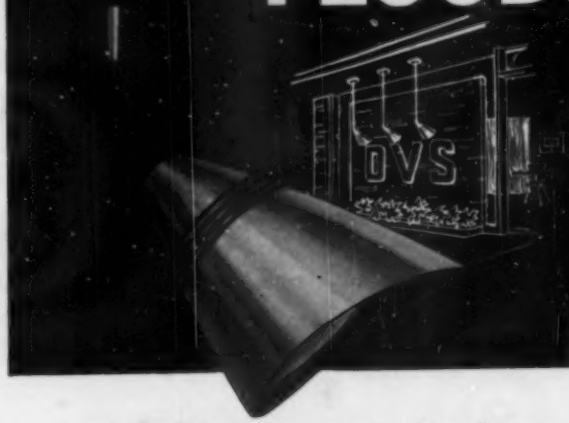

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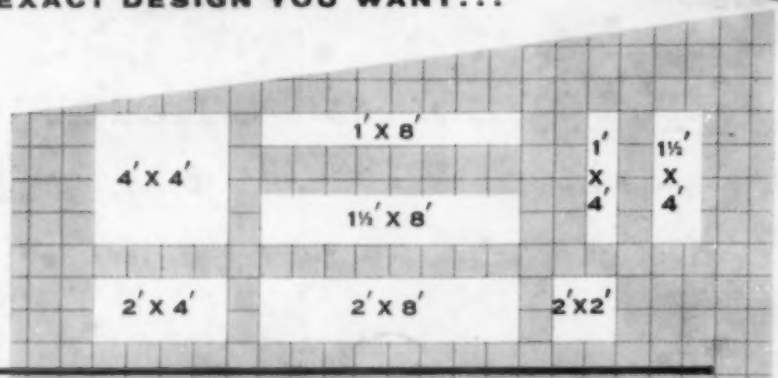

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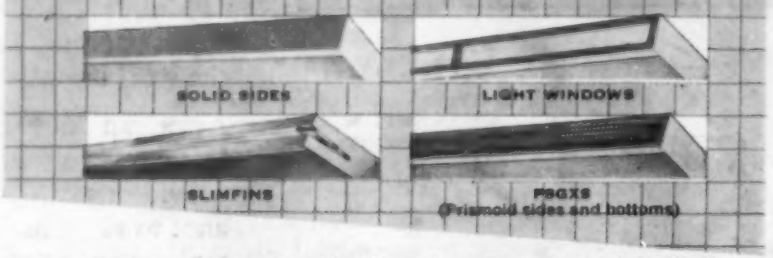

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